THE IMPACT OF TRANSITIONING DONOR HEALTH PROGRAMS:

EVIDENCE FROM THE PEPFAR GEOGRAPHIC PRIORITIZATION IN UGANDA

by
Jess Alan Wilhelm

A dissertation submitted to Johns Hopkins University in conformity with the requirements for the degree of Doctor of Philosophy

Baltimore, Maryland
January 2019

Abstract

Declining donor funding for HIV/AIDS has increased interest in transitioning donor programs to national control. However, evidence on the impact of transitioning health facilities is limited. The PEPFAR Geographic Prioritization in Uganda targeted 734 facilities for transition from PEPFAR site-level support during 2015–2016.

This study uses a survey conducted in mid-2017 in 226 health facilities with past or present PEPFAR support. I examined the effects of transition at the facility level by comparing facilities transitioned to those maintained on PEPFAR. The survey gathered information on service delivery and human resources pre- and post-transition. An individual module collected information on time-allocation, motivation, and incentives from 479 health workers. I also obtained counts of HIV and non-HIV services provided by facilities during the period October 2013–December 2017 from DHIS2 and counts of health workers employed at facilities for December 2015–December 2017 from HRHIS. I analyzed trends for these outcomes using interrupted time series analysis.

Transition was associated with reduced supervision, incentives, and training as well as the termination of 9.5% of HIV workers — mostly lay health workers. There were no significant changes in staffing ratios for formal health workers. Relative to maintenance, transition facility in-charges were more likely to report discontinuation of HIV outreach and worsening access to and quality of HIV care. Yet, trends in service utilization indicators did not differ between transition and maintenance. Private not for-profit facilities were more likely than public

facilities to report declining frequency of supervision and loss of staff. Private for-profit facilities have had declining HIV testing & counseling relative to public facilities and are more likely to report reduced time on HIV care and discontinuation of outreach.

This study was limited by the short follow-up period. The loss of outreach and decline in training could lead to deterioration in HIV service delivery in the long-term. However, it is also possible that the health system is coping with loss of support. Further research is needed in a variety of settings, with longer follow-up, in order to better understand the impacts of transitioning HIV health programs.

Thesis Committee Members:

Committee Members

Sara Bennett, PhD, MPhil (Advisor)
Professor
Department of International Health

David Dowdy, MD, PhD (Chair)
Associate Professor
Department of Epidemiology

Ligia Paina, PhD
Assistant Professor
Department of International Health

Elizabeth Colantuoni, PhD
Associate Scientist
Department of Biostatistics

Alternate Committee Members

Andreea Creanga, MD, PhD
Associate Professor
Department of International Health

Stella Babalola, PhD
Associate Professor
Department of Health, Behavior & Society

Preface

I would like to acknowledge the direct contributions of my study collaborators from Johns Hopkins University (Dr. Ligia Paina, Dr. Daniela Rodríguez, Mary Qiu, and Dr. Sara Bennett) and Makerere University (Moses Makuru, Dr. Henry Zakumumpa, and Dr. Freddie Ssengooba), without which this thesis could not have been completed. Antonio Trujillo provided helpful input to the parent study for the thesis. Some of the datasets used in this thesis are maintained by the Ministry of Health of Uganda, and we appreciate the Ministry making the data available to the research team. We thank the former MEEPP project of Social & Scientific Systems, Inc. for sharing matching files.

I would like to thank my committee members (Drs. Sara Bennett, Ligia Paina, David Dowdy, and Elizabeth Colantuoni) and alternates (Drs. Andreea Creanga and Stella Babalola) for their input during the process. In particular, my advisor, Sara Bennett, provided consistent support throughout the project and development of this thesis. I would like to thank my International Health PhD cohort ('15), who provided valuable support — moral and otherwise — over the past three years.

The study on which this thesis is based was funded by the United States Agency for International Development (USAID) through a Project SOAR grant to Population Council. The views expressed in this thesis do not necessarily represent those of Population Council or USAID.

Table of Contents

Tables 9

Figures 11

List of terms and abbreviations 12

A Note about Terminology 15

Chapter 1. Introduction 16

1.1 Overview and Study Objectives *16*

1.2 Background on PEPFAR & the Geographic Prioritization *16*

1.3 Background on Uganda's HIV/AIDS Response & the PEPFAR GP in Uganda *20*

1.4 Literature Review of Health Program Transition *23*

1.4.1 Previous HIV Transition Experiences 26

1.5 Literature Review of HIV Program Impacts on Health Systems *29*

1.5.1 Impacts of International HIV Funding for other Diseases and Health Systems Strengthening 29

1.5.2 Impacts of Donor HIV Funding on Human Resources for Health 32

1.5.3 Impact of Donor HIV Programs on non-HIV Service Delivery 33

1.6 Conceptual Model *36*

1.6.1 Review of Conceptual Models of Indirect Health System Impacts 37

1.6.2 Synthesis of Impacts 39

1.6.3 Conceptual Model of Health System Impacts of HIV Program Transition 44

1.6.4 Application of Conceptual Framework to the PEPFAR GP in Uganda 47

1.6.5 Hypotheses of PEPFAR GP Impacts in Uganda 51

1.7 Research Questions & Methods *52*

1.7.1 The Parent Study: Mixed Methods Evaluations of PEPFAR GP in Kenya & Uganda 53

1.7.2 Defining Transition – Official PEPFAR & Facility Self-Report 57

1.7.3 Modeling Transition Impacts 58

1.8 Thesis Organization *59*

Chapter 2. "The Impact of Donor Transition on Human Resources for Health: Evidence from the PEPFAR Geographic Prioritization in Uganda" **61**

2.1 Abstract *61*

2.2 Introduction *62*

2.2.1 Objectives 67

2.3 Methods *68*

2.3.1 Facility Survey – Data Source 68

2.3.2 Facility Survey – Outcomes & Analysis 69

2.3.3 Human Resources for Health Information System – Data Sources 71

2.3.4 HRHIS Data - Analysis 74

2.4 Results *77*

2.4.1 Facility Survey Results 77

2.4.2 HRHIS Data: All Available Data from Public Health Facilities 85

2.4.3 HRHIS Data: Survey Facility Sample 89

2.5 Discussion ... *93*

Chapter 3. "The Impact PEPFAR Geographic Prioritization on HIV & non-HIV service delivery in Uganda" ... 99

3.1 Abstract ... *99*

3.2 Introduction ... *100*
3.2.1 Objectives ... 102

3.3 Methods ... *102*
3.3.1 Facility Survey Data: Objectives 1 & 2 ... 103
3.3.2 DHIS2 Data & Analysis: Objective 3 ... 106

3.4 Results ... *114*
3.4.1 Facility Survey Sample Characteristics ... 114
3.4.2 Objective 1: Discontinuation of Services ... 117
3.4.3 Objective 2: Perceptions of Patient Access and Service Quality ... 118
3.4.4 Objective 3: Effects on Service Volume ... 120
3.4.5 Secondary Analysis: Using Facility Survey Sample with Self-Reported Transition Indicator ... 131
3.4.6 Sensitivity Analysis: Sensitivity to Transition Timing ... 133
3.4.7 Sensitivity to Effect Measure Modifiers: Region, Level, and Ownership ... 135
3.4.8 Sensitivity to Model Misspecification: Bootstrap ... 136

3.5 Discussion ... *137*
3.5.1 Limitations ... 141
3.5.2 Conclusions ... 144

Chapter 4. "PEPFAR Transition in Uganda Impacted Private for-Profit, Private not for-Profit, and Public Facilities Differently" ... 145

4.1 Abstract ... *145*

4.2 Introduction ... *146*
4.2.1 The Private Sector in Uganda ... 146
4.2.2 Private HIV Provision in Uganda ... 148
4.2.3 The Role of Donors in Private Sector HIV Service Provision ... 149
4.2.4 Private Facilities in Transition ... 150
4.2.5 Objectives ... 151

4.3 Methods ... *152*
4.3.1 Data Source: Facility Survey ... 153
4.3.2 Facility Survey Analysis ... 158
4.3.3 DHIS2 Data ... 161
4.3.4 DHIS2 Analysis ... 162

4.4 Results ... *165*
4.4.1 Description of data ... 165
4.4.2 Facility Survey: Effects on Health Service Inputs ... 167
4.4.3 Facility Survey: Effects on Health Service Delivery ... 170
4.4.4 DHIS2: Impacts on HIV Service Volume ... 173

4.5 Discussion ... *182*
4.5.1 Limitations ... 185
4.5.2 Conclusions & Implications ... 187

Chapter 5. Conclusions & Policy Implications ... 189

5.1 Summary of results ... *189*

5.1.1 Comparing Hypotheses and Results 189
5.1.2 Discussion of GP Findings in Uganda 191

5.2 A Note on the Context and Transition Process 192

5.3 Lessons for Transitions in other Settings 194
5.3.1 Lessons from the GP Model: Suddenness 195
5.3.2 Lessons from the GP Model: Prioritization 195
5.3.3 Lessons from the GP Model: Transition to Central Support 196
5.3.4 Lessons from the GP Model: Summary 198
5.3.5 Lessons from PEPFAR GP's Results, with Caveats 199

Chapter 6. Annex.................... 201

6.1 Annex for Introduction 201
6.1.1 Search Terms for Review of Conceptual Frameworks 201
6.1.2 Sample Size Calculation 201

6.2 Annex: Paper 1....................203
6.2.1 Equation 1:....................203
6.2.2 Paper 1 – Additional Tables & Figures 205

6.3 Annex: Paper 2....................213
6.3.1 Rationale for Indicators 213
6.3.2 DHIS2 Model Specification: 215
6.3.3 DHIS2 Data Cleaning: 217
6.3.4 DHIS2 Full Model Results: Full Sample (ITT) 219
6.3.5 Sensitivity Analysis Tables: Effect Measure Modification 222
6.3.6 Full Table for Cohort Retention (Full ITT Sample & Survey-only Sample)....................227

6.4 Annex: Paper 3....................228
6.4.1 Data Cleaning....................228
6.4.2 Paper 3 – Additional Tables & Figures 229

Chapter 7. References 235

Curriculum Vitae 245

Tables

Table 1: PEPFAR Uganda's Classification of Districts for Prioritization 21
Table 2: Indirect Effects of HIV Programs – A Summary of the Literature & Extension to HIV Program Transition, with particular application to the PEPFAR GP in Uganda 40
Table 3: Possible Transition Processes and their hypothesized Health System Effects under the PEPFAR GP 52
Table 4: Dissertation Papers, Objectives, and Methods 53
Table 5: SOAR Study Overview 54
Table 6: Comparison of Reporting Transition Status in Facility Survey Sample 58
Table 7: Objectives, Outcomes, and Data Sources 71
Table 8: Typical (Approved) Staff Positions by Facility Type (Public Only) 72
Table 9: HRHIS Data Extraction Timeline & Counts 74
Table 10: Descriptive Statistics of Survey Facilities (Unweighted) 78
Table 11: Changes in Support for HRH in Survey Facilities (Weighted) 80
Table 12: HRH Responses to Transition 82
Table 13: Multivariate Regression of Annualized HIV Training Days per Worker 84
Table 14: Multivariate Models of Staffing Ratios 88
Table 15: Multivariate Regression of Staffing Ratios (Facility Survey Sample) 92
Table 16: Study Objectives, Data Sources, Outcomes, and Methods 104
Table 17: DHIS2 Indicators used in Uganda 107
Table 18: Numbers of Facilities and Observations in Analysis 109
Table 19: Unweighted Facility Characteristics in Survey Sample 116
Table 20: Discontinuation of HIV and non-HIV Services 118
Table 21: In-Charge Reported Change in Access and Quality of Care 119
Table 22: Change in Quality of Specific HIV and non-HIV Services 120
Table 23: Trends in Service Delivery (ITT Analysis) 121
Table 24: Trends in Service Delivery (Survey Sample) 132
Table 25: Sensitivity to Transition Midpoint, Full Sample (Trend Analysis) 134
Table 26: Sensitivity to Transition Window, Full Sample (D-in-D Analysis) 135
Table 27: Bootstrap Confidence Intervals for Count Models (Trend Analysis) 137
Table 28: Bootstrap Confidence Intervals for D-in-D models 137
Table 29: Projected Differences in Service Volume at 12 months following Transition (ITT Analysis) 140
Table 30: Objectives and Methods 152
Table 31: Transition Impact Index 156
Table 32: Hypotheses and Comparisons 161
Table 33: Facility Survey Descriptive Statistics (Unweighted Proportions) 166
Table 34: DHIS2 Descriptive Statistics (Unweighted Proportions) 167
Table 35: Facility Survey Multivariate Regression Models (Changes in Support) 169
Table 36: Facility Survey Multivariate Regression Models (Facility & Worker Responses) 171
Table 37: DHIS2 D-in-D Regression Models for HTC 175
Table 38: Trend Analysis of Current on ART for PNFPs vs. Public 179
Table 39: 12-month Cohort Retention for PNFPs vs. Public 181
Table 40: Comparing Hypothesized Transition Outcomes to Study Findings 191
Table 41: Power Simulation Results 203
Table 42: Facility Survey Descriptive Statistics (Weighted Proportions) 205
Table 43: Binomial Logistics Model of Salary Support 206
Table 44: Key Parameters and Results of Data Cleaning - DHIS2 218
Table 45: Full DHIS2 Base Models (Count Indicators, Trend Analysis) 219
Table 46: Full DHIS2 Base Models (Proportion Indicators, D-in-D Analysis) 221
Table 47: Effect Measure Modification by Region (Trend Analysis) 222
Table 48: Effect Measure Modification by Region (D-in-D Analysis) 222
Table 49: Effect Measure Modification by Facility Level (Trend Analysis) 223
Table 50: Effect Measure Modification by Level for (D-in-D Analysis) 224

Table 51: Effect Measure Modification by Ownership (Trend Analysis) ... 225
Table 52: Effect Measure Modification by Ownership (D-in-D Analysis) ... 226
Table 53: Models for Cohort Retention (Full & Facility Survey Sample) ... 227
Table 54: Weighted, Unadjusted Proportion of Public, PNFP, and PFP Facilities Reporting Selected Outcomes (Facility Survey) ... 229
Table 55: Non-significant Findings for Facility Survey Outcomes ... 230
Table 56: Sensitivity Analysis for HTC in PFPs ... 231
Table 57: Sensitivity Analysis for HTC in PNFPs ... 232
Table 58: Sensitivity Analysis for Cohort Retention ... 233

Figures

Figure 1: Map of Uganda Districts by Geographic Prioritization Classification and Number of Sites to be Transitioned ... 22
Figure 2: Donor HIV Funding Trends 2002—2016 ... 24
Figure 3: Conceptual Model for Assessing Health System Impacts during Transition of an HIV Program 47
Figure 4: Schematic of Difference-in-Differences in Trends (a.k.a. trend analysis) ... 59
Figure 5: Histogram of HIV Training Days per Worker per Year by Transition Status ... 85
Figure 6: All Cadre Staffing Trends by Transition Status (Full Sample) ... 86
Figure 7: Nurses and Midwife Staffing (Full Sample) ... 89
Figure 8: All Cadre Staffing Ratios in Survey Facilities (Survey Sample) ... 90
Figure 9: Nurse and Midwife Staffing Ratios in Survey Facilities (Survey Sample) ... 91
Figure 10: Transition Dates in Facility Survey ... 117
Figure 11: Trends in HTC ... 122
Figure 12: Trends in HTC Yield ... 123
Figure 13: Trends in Current on ART ... 124
Figure 14: Trends in New on ART ... 125
Figure 15: Trends in Cohort Retention at 12-months ... 126
Figure 16: Trends in OPD Visits ... 127
Figure 17: Trends in Coverage of ANC4+ ... 128
Figure 18: Trends in IPT2 Coverage ... 129
Figure 19: Trends in Facility Deliveries ... 130
Figure 20: Trends in DPT3 or Penta-3 Immunization ... 131
Figure 21: Trends in Cohort Retention (Facility Survey Sample) ... 133
Figure 22: Transition Impact Index Scores by Transition Status ... 157
Figure 23: Histogram of Annualized HIV Training Days per Worker since Transition ... 173
Figure 24: Trends in HTC in Public, PNFP, and PFP Facilities ... 174
Figure 25: Trends in Current on ART in Transitioned Public and PNFP Facilities (All) ... 176
Figure 26: Trends in Current on ART (HC II & III) ... 177
Figure 27: Trends in Current on ART (HC IV & Hospital) ... 178
Figure 28: Trends in Cohort Retention at Transitioned Public and PNFP Facilities ... 180
Figure 29: All Cadre Staffing Trends in PEPFAR Facilities by Region (Full Sample) ... 207
Figure 30: All Cadre Staffing Trends in PEPFAR Facilities by Level (Full Sample) ... 208
Figure 31: Histogram of Filled-to-Approved Ratio (All Cadre) ... 209
Figure 32: Histogram of Nurse and Midwives Staffing Ratios ... 210
Figure 33: Nurse and Midwife Staffing by Region (Full Sample) ... 211
Figure 34: Nurse and Midwife Staffing by Level (Full Sample) ... 212
Figure 35: Trends in Current on ART for Large Facilities (PNFP Disaggregated) ... 234

List of terms and abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal care
ANC4+	4 or more antenatal care visits
ART	Antiretroviral therapy
ARV	Antiretroviral
BMGF	The Bill & Melinda Gates Foundation
C.I.	Confidence Interval
CHW	Community health workers
COP	Country operating plan
CS	Central Support
CSD	Central support district
CSW	Commercial sex worker
DAH	Development assistance for health
DALY	Disability-adjusted life year
DHIS2	District Health Information System 2.0
DHO	District Health Office
DHS	Demographic and Health Survey
D-in-D	Difference-in-difference
DPT	Diphtheria, Pertussis, and Tetanus
EID	Early infant diagnosis
FY	Fiscal year
GAVI	Global Alliance for Vaccines and Immunization
GFATM	The Global Fund to Fight AIDS, Tuberculosis, & Malaria
GHI	Global health initiatives
GoU	Government of Uganda
GP	Geographic Prioritization
HC	Health Centre
Hib	Haemophilus influenzae type B
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
HRH	Human resources for health
HRHIS	Human Resources for Health Information System
HSS	Health system strengthening
HSSP	Health Sector Strategic Plan
HTC	HIV Testing & Counseling
HTC_Pos	HIV Testing & Counseling with positive test result
ICC	Intra-cluster correlation coefficient
IDU	Injection drug user
iHRIS	Integrated Human Resources Information System
IM	Implementing mechanism
IOM	Institute of Medicine
IP	Implementing partner
iPSL	Integrated PEPFAR Site List
IPT2	Intermittent prophylactic therapy in pregnancy, 2^{nd} dose

IPTp	Intermittent prophylactic therapy in pregnancy
IRR	Incident rate ratio
ITT	Intention to treat
JHU	Johns Hopkins University
KP	Key population
LCS	Longitudinal case study
LGBT	Lesbian, Gay, Bisexual, and Transgender
LMICs	Low- and middle-income countries
M&E	Monitoring & Evaluation
MAR	Missing at random
MD	Maintenance District
MMR	Measles, Mumps, & Rubella
MNCH	Maternal, neonatal, and child health
MoH	Ministry of Health
MSH	Management Sciences for Health
MSM	Men who have sex with men
NGO	Non-governmental organization
OPD	Outpatient department visit
OR	Odds ratio
OUMB	Orthodox Church of Uganda Medical Bureau
p.p.	Percentage point
penta	Pentavalent immunization (DPT+Hib+Hep B)
PEPFAR	The President's Emergency Plan for AIDS Relief
PFP	Private for profit
PLHIV	People living with HIV
PMTCT	Prevention of mother-to-child transmission
PNC	Postnatal care
PNFP	Private not for-profit
PWID	People who inject drugs
QA	Quality assurance
QI	Quality improvement
RHITES-E	Regional Health Integration to Enhance Services – Eastern Uganda
ROC	Receiver operating characteristic
S.E.	Standard error
SBA	Skilled birth attendance
SI	Strategic information
SNU	Sub-national unit
SSA	Sub-Saharan Africa
STAR-E	Strengthening TB and HIV & AIDS Responses in Eastern Uganda
STI	Sexually transmitted infections
SUD	Scale-Up District
TB	Tuberculosis
TTT	Training the trainers
UCMB	Uganda Catholic Medical Bureau
UMMB	Uganda Muslim Medical Bureau
UPMPA	Uganda Private Medical Practitioners Association

UNAIDS	United Nations Programme on HIV/AIDS
UPMB	Uganda Protestant Medical Bureau
USAID	United States Agency for International Development
VHT	Voluntary HIV testing
VL	Viral load
WHO	World Health Organization

A Note about Terminology

This thesis is about transition of donor health programs and the effects that transition has on the health system. I do not attempt to formally define transition. However, for the reader's benefit, transition should be understood as any loss of donor support that was formerly provided to one or more components or units of the health system of a recipient nation. By this definition, transition has been occurring for almost as long as there have been donor health programs. Yet, transition remains little studied and poorly defined.

The empirical evidence used in this thesis comes exclusively from one setting, Uganda in the mid-2010s, and focuses on one policy that guided transition in that setting, the PEPFAR Geographic Prioritization. While I often use the terms "transition" and "Geographic Prioritization" interchangeably in this thesis, transition should be understood as an occurrence taking place in the real world while PEPFAR's Geographic Prioritization is a policy process that is associated with transition. It goes without saying that policies and reality do not always agree.

Chapter 1. Introduction

1.1 *Overview and Study Objectives*

This thesis seeks to empirically assess the impacts of transition from site-level PEPFAR support in Uganda associated with the PEPFAR Geographic Prioritization (GP). I start by summarizing PEPFAR, the GP process, Uganda's HIV/AIDS situation, and PEPFAR's role in the HIV/AIDS response. I reviewed the literature on transition, and finding no suitable conceptual frameworks for the impacts of transition, I developed my own. Then, in the first of three papers, I measured the changes in PEPFAR support for human resources for health and the subsequent responses by health workers. Next, in the second paper, I examined the effects of transition from PEPFAR support on HIV and non-HIV services. In the third paper, I compared the effects of transition for private for-profit, private not for-profit, and public health facilities. Finally, I summarized the results and identify lessons that can be drawn for the GP in Uganda and future aid transitions.

1.2 *Background on PEPFAR & the Geographic Prioritization*

The President's Emergency Plan for AIDS Relief (PEPFAR) has been a cornerstone of global HIV/AIDS assistance and accounted for more than half of donor funding for HIV in LMICs in 2015 (1). The 2008 Lantos-Hyde bill that reauthorized PEPFAR, and subsequent PEPFAR planning documents, have encouraged PEPFAR to increase the sustainability of its operations. An evaluation conducted by the Institute of Medicine (IOM) called for increased efficiency in targeting limited resources to achieve program goals and to engage in long-term capacity building in support of sustainability (2). The PEPFAR 3.0 strategy for 2014–2018 has encouraged sustainability within operations, including the addition of a sustainability index, increases in domestic financial share, and expansion of the "Country Health Partnership" approach (3). The vague goals of "sustainability" and "partnership" outlined in the PEPFAR 3.0 strategy were clarified in the 2015 Guidance for Country Operating Plans (COPs) as the Geographic Prioritization (4).

The PEPFAR GP was introduced in guidance to PEPFAR country missions in 2015. It encouraged missions to identify locations and populations for scale-up over FYs 2016 & 2017 as part of the COP 2015 process. The primary criteria for selection of scale-up was identifying the areas and populations that contributed to 80% of the national total of people living with HIV (PLHIV), which would receive a package of services aimed at achieving saturation under the UNAIDS 90-90-90 goals. The 90-90-90 goals state that by 2020, 90% of PLHIV will know their status, 90% of those with known status will be on ART, and 90% of those on ART will have achieve viral suppression (5). Saturation would consist of 80% of PLHIV being on ART (90% of HIV+ pregnant women) across all age-sex groups. Local HIV prevalence and the presence of key populations (KPs) were other criteria in PEPFAR's Geographic Prioritization process (4).

Locations not designated for scale-up would either receive a "maintenance package of services" to be defined by PEPFAR country missions or be transitioned to "central support" (4). In COP Guidance for 2017, a fourth category of "attained" was added for sub-national units (e.g., districts) that have achieved the 80% ART coverage target for all age-sex groups (6).

"Central support" is a term that is not defined in PEPFAR documents. It is applied both to sub-national units and to individual facilities. While it may imply that national health ministries (i.e. central government) would be responsible for HIV care, this interpretation does not correspond to the reality of decentralized health care management in Uganda. The term "transition to central support" is also applied to private facilities, including standalone private for-profit providers with no conceivable “central” source of support at present. “Central support” could also imply that PEPFAR intends to continue providing support, but only through centralized systems for commodities, laboratory systems, and health system planning. However, not all facilities will benefit from or have access to these systems.

COP Guidance for 2015 set standards for prioritization of sub-national units (SNUs) for scale-up, but it did not require that country missions identify SNUs for transition to central support. Nor did COP 2015 guidance provide guidelines for how transition locations or populations would be identified, other than as a residual of the process of identifying locations and populations for scale-up. Country missions themselves either identified SNUs for central support among those not receiving scale-up, or they did not identify any SNUs for central support at all (4).

In addition to providing guidance for classifying SNUs, COP 2015 guidance was specific in advocating that PEPFAR country programs discontinue support to HTC and PMTCT sites with fewer than 4 HIV-positive tests per year and in consolidating low-volume ART sites, “PEPFAR should work with the host country government and other stakeholders to transition support for low-volume ART sites or refer current patients to higher volume sites to improve quality of care.” (p. 78) (4).

While the guidance on transition was limited, the objective of achieving cost savings from maintenance and central-support was clear: “Program costs and trade-offs should be taken into account when determining maintenance support for other locations and populations.” (p. 79) (4). There was no specific mention of how PEPFAR teams should assess readiness of locations or facilities for transition or implement the transition process. There is requirement for a “transition plan”, but that is only in the context of program activities that are to be discontinued as part of the simultaneous "activity pivot" wherein the support provided to facilities that are maintained on PEPFAR is changing slightly, and not for facilities and SNUs that are to be discontinued.

COP Guidance for 2016 largely built-on the guidance from 2015. Countries were encouraged to use COP 2016 to assess the progress of scale-up to saturation in FY2016 and re-consider their classification for FY2017. The only mention of SNUs selected for transition is a deadline for transition to be completed: "In central support districts, site-specific activities will transition to government or other support by the end of September 2016 and by no later than March 2017. Central support districts will continue to receive PEPFAR national support for overarching activities, such as quality assurance and quality improvement (QA/QI) to ensure that patients continue to receive quality services." (p. 59) Beyond this timeline and the re-iteration of continued national-level support for transition SNUs, there is no prescriptive guidance on the transition process to be applied for either the central-support SNUs or low-volume sites transitioned (7).

COP Guidance for 2017 outlined strategies for each investment category, including the new category "attained". Uganda's COP 2017 identifies 40 out of 112 districts containing 50% of PLHIV as being predicted to reach attained status in FY2018. Interestingly, five districts (Amolatar, Buvuma, Koboko, Nakasongola, and Pallisa) reached attained status from maintenance, without receiving scale-up support. Attained are classified together with sustained districts, indicating that these districts will no longer receive intensive scale-up support (if they ever did) but will be supported to maintain their routine progress (pg. 42) (8).

However, PEPFAR guidance on attained also notes that, "In the current environment there is an urgent need to shift program resources to the locations and populations where most new HIV infections are likely to occur." (pg. 78). COP Guidance also stipulates that low-yield sites that don't contribute should be considered for transition. In SNUs identified as maintenance, the PEPFAR country offices are advised that, "While PEPFAR programs phase out of active counseling and testing and new ART enrolment, PEPFAR service or technical support for other programs must be done as well through careful transition planning to ensure that harmful consequences are avoided." (6) This is the first mention in COP guidance of transition planning, and it comes two years after the initiation of the GP.

1.3 Background on Uganda's HIV/AIDS Response & the PEPFAR GP in Uganda

Uganda was one of the first countries in Sub-Saharan Africa to openly address HIV/AIDS in 1986 as a national priority and has been considered by many as an HIV success story (9). The cause of Uganda's success in reducing HIV prevalence in the 1990s is debated (9, 10). Regardless, HIV incidence increased again in the late 2000s (11) and Uganda has been faulted for active opposition to condoms by social conservatives as well as draconian anti-LGBT legislation (12). Moreover, Uganda is among the many African countries that have not met their Abuja Declaration commitment to spend 15% of their budgets on health, with health spending taking up 10.8% of the budget in 2014 (13).

The bulk of HIV expenditure in Uganda has come from donors, including PEPFAR. Uganda is classified as a "long-term strategy" PEPFAR country (4). "Long-term strategy" is a category that, under PEPFAR FY2014 Guidance, is characterized by high need for external support, high HIV prevalence, and limited domestic financial resources (14). Uganda is heavily dependent on donor financing for its HIV/AIDS response, with 90% of funding for ARVs coming from PEPFAR and the Global Fund (8). The Government of Uganda (GoU) 's share of total HIV/AIDS spending in 2013 was only 12% while households accounted for more than 20%

of HIV/AIDS spending through out-of-pocket payments (15). Recent National Health Accounts put the GoU's share of HIV/AIDS spending at 8.2% in FY2015/16 with 84% coming from development partners (16). Uganda's high level of aid dependency for HIV makes it an interesting test case for transition.

The national PEPFAR Country Operational Plans (COPs) for Uganda indicate how the GP has been applied in the country. In Uganda, the decision on scale-up was made at the unit of the district. Districts were ranked according to the number of PLHIV. The top districts in number of PLHIV were allocated to scale-up until the scale-up districts accounted for 80% of the PLHIV in Uganda. Five additional low-burden (i.e., not contributing to 80% of PLHIV) district with high-prevalence (≥7.3%) that had substantial numbers of KP/PPs or who were sources of patients receiving care at regional referral hospitals/centers of excellence in neighboring districts were included. Ten "central support" districts were selected among 43 low-burden/low-prevalence districts based on their having limited prior support (four districts had only received district-level support and six had limited technical assistance only). Table 1 shows the district classification and Figure 1 shows the distribution of facilities under the PEPFAR Geographic Prioritization in Uganda (17).

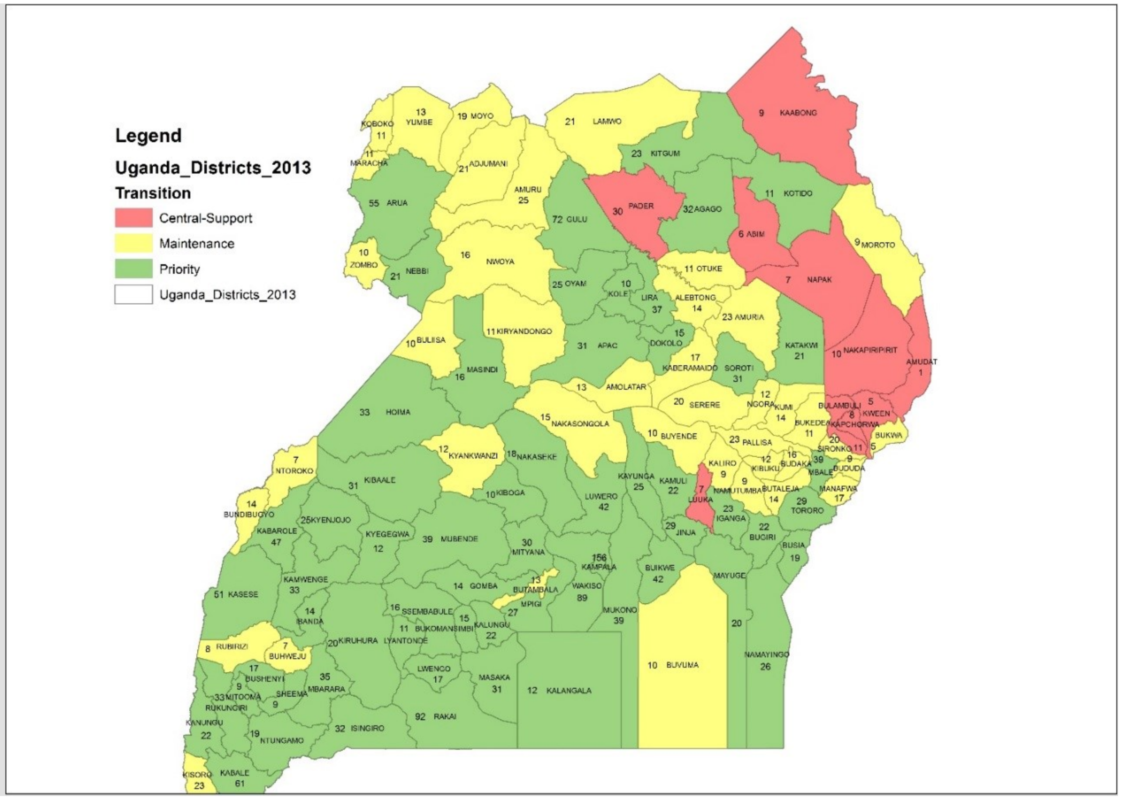
Table 1: PEPFAR Uganda's Classification of Districts for Prioritization

<table>
<tr><th colspan="2"></th><th colspan="3">Number of PLHIV</th></tr>
<tr><th>HIV Prevalence</th><th>Presence of KP/PPs or Proximity to Referral Hospitals</th><th>High (Among Top 80%)</th><th colspan="2">Low (Among Bottom 20%)</th></tr>
<tr><td rowspan="2">≥7.3%</td><td>Yes</td><td rowspan="2">38</td><td colspan="2">5</td></tr>
<tr><td>No</td><td colspan="2">8</td></tr>
<tr><td><7.3%</td><td>No</td><td>18</td><td>33</td><td>10</td></tr>
</table>

Priority	Maintenance	Central Support

Source: PEPFAR, Uganda COP 2015
Footnote: KP/PP: Key population/Priority population. PLHIV: People living with HIV

Figure 1: Map of Uganda Districts by Geographic Prioritization Classification and Number of Sites to be Transitioned



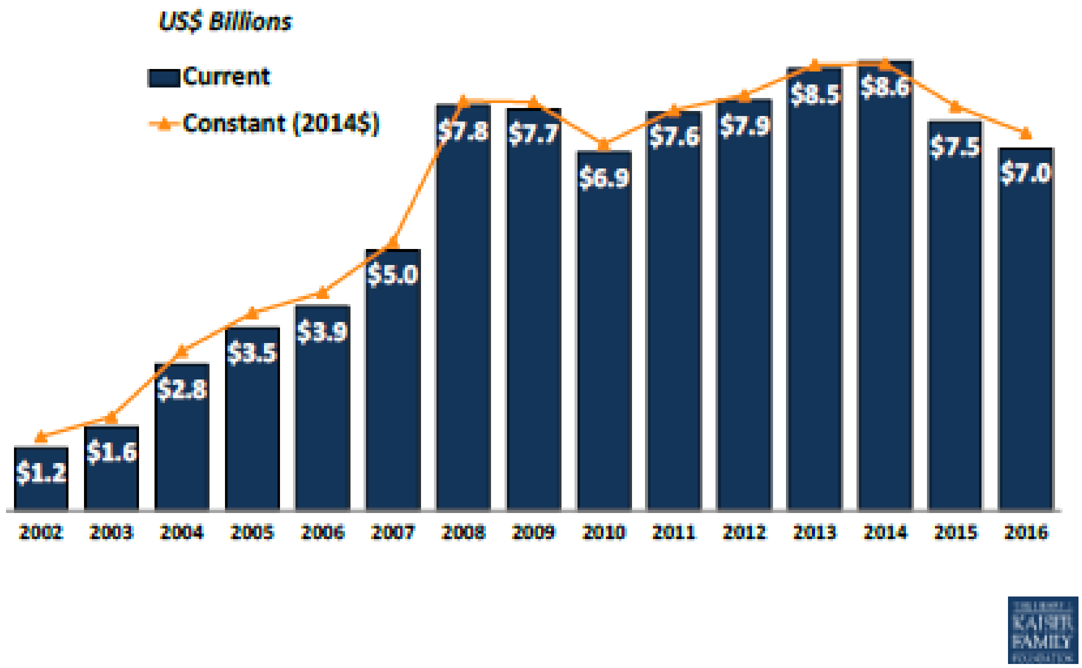
The 10 central support districts contained 94 PEPFAR-supported facilities in FY2014. An additional 640 PEPFAR facilities were selected for transition outside of the central-support districts selected based on three criteria: 1.) Low-volume sites with <12 HTC HIV+, <5 HIV+ in PMTCT, and <21 on ART (in scale-up districts), or 2.) <5 HIV+ in PMTCT and <21 on ART (in maintenance districts), and 3.) HTC standalone sites, regardless of their volume. Between FY2015 and FY2017, the number of PEPFAR-supported sites in Uganda was supposed to decline from 2,537 to 1,803. The bulk of the sites intended for transitioned were low-volume sites outside of the central support districts. Many of these low-HIV volume facilities were private, including a substantial number of private for-profit (PFP) facilities. USAID provided the study team with multiple, conflicting lists of facilities to be transitioned. This left the research team with some uncertainty about transition assignment, particularly among the low-volume transition sites. Additionally, it became clear that the dataset used for identifying "low volume" sites was PEPFAR's DATIM, which is cleaned to produce a lower bound of attributable services, not an estimate of actual services provided. Therefore, a facility that provides HTC, ART, and PMTCT but is only supported by PEPFAR for HTC will appear as a HTC-only site and be selected for transition on that basis.

While the Geographic Prioritization in COP 2015 and 2016 represents a break from prior PEPFAR practice in Uganda by discontinuing support to (i.e., transitioning) whole SNUs, the strategy builds on practices documented in prior COPs (15) that allocate resources according to needs. Uganda's transition involves a greater number of low-volume facilities outside of "central support" districts than facilities within those districts. There is an ongoing churn in the supported facilities that pre-existed transition, as implementing partners change and so does their view of which sites are contributing towards PEPFAR targets. In this sense, the GP launched in 2015 may be seen as a deepening and formalization of an existing trend of focusing on facilities that yield patients, with the addition of whole-SNU transitions.

1.4 Literature Review of Health Program Transition

The PEPFAR GP was implemented in Uganda at a time when international assistance for HIV has been declining. According to a joint report of the Kaiser Family Foundation and UNAIDS, total HIV assistance declined 19% between 2014 and 2016 (1). Figure 2 plots global donor funding trends for HIV in constant 2014 USD.

Figure 2: Donor HIV Funding Trends 2002–2016



Source: Kates, Wexler, & Lief, 2017

As of 2018, PEPFAR has been active for 15 years and has spanned three different U.S. Presidents' administrations. The PEPFAR GP could be viewed as a sign of donor fatigue in HIV that will likely be reinforced by continued trends in economic and political isolation in Europe and the United States. Budget proposals made by the Trump administration in 2017 that called for a 28% cut and included a clause to "maintain current commitments and all current patient levels on HIV/AIDS treatment under the President's Emergency Plan for AIDS Relief (PEPFAR)" (pg. 34) (18) left the door open to not support additional enrollment on HIV services that is necessary to achieve 90-90-90 targets. These proposals were rejected by Congress in 2017 (19). However, foreign policy experts have claimed that the erratic budgeting process has wasted resources and prevented long-term planning (20).

While ambitious goals have been set for ending AIDS by 2030, with considerable resources needed to meet them (21), it is unclear if current donors are willing to sustain, much less increase, their support. Without new entrants of non-traditional donors in the HIV funding environment (e.g., China), large-scale transitions of HIV/AIDS programs are to be expected in coming years.

The Global Fund to Fight AIDS, TB, and Malaria (GFATM) also has a large role in Uganda, but more than 90% of its funding is used to procure commodities for the public sector (8). Uganda has a GFATM grant agreement for $212 million for HIV/AIDS from July 2015 to December 2017, which includes a costed extension for July-December 2017 (22). GFATM disbursements for HIV/AIDS have remained steady over the period of 2015 to 2018 (23); therefore, I expect the Global Funds to have limited influence on the PEPFAR GP process in Uganda. GFATM is certainly not replacing the services that PEPFAR IPs once provided at the health facility level.

PEPFAR has already transitioned programs in South Africa, Botswana, and Namibia, as well as regional support to programs in the Eastern Caribbean (24). PEPFAR's new role in these countries is primarily one of co-financing national programs. These nations have more financial and managerial resources to devote to HIV than do aid-dependent nations, like Uganda or Malawi. They also have relatively strong political commitment to HIV. However, as we will see for South Africa, these conditions may not be sufficient for a smooth HIV transition.

In low- and lower-middle income countries (LMICs), including Uganda, PEPFAR is applying the GP strategy that transitions only a small portion of the total HIV burden to central support. Given the likelihood of more extensive transitions to come, it is important to scrutinize Uganda's experience to assess readiness for more far-reaching transitions in the future and to anticipate the potential impacts. Past experience of transition can also shed light on the expected outcomes of the GP in Uganda.

1.4.1 Previous HIV Transition Experiences

Prior experiences with transitions from HIV assistance are relevant to the evaluation of the PEPFAR GP. The experience of the Avahan project in India, PEPFAR's transitions in Southern Africa and the Eastern Caribbean, and GFATM's departure from Eastern Europe are cases that have been studied in depth (24-28). These HIV transitions constitute either whole-country donor exits or major scale-backs of engagement, whereas the GP in Uganda comprises only a regional and site-level withdrawal of support with continued above-site commodity and laboratory support. However, the lessons from national-level transitions are still likely to be relevant to GP process.

The scale of HIV/AIDS and the PEPFAR program in South Africa makes this country's experience particularly important. The transition was laid out in the PEPFAR Partnership Framework in 2010 with substantial host country engagement in program governance. However, in spite of a relatively long transition timeline, PEPFAR has been criticized for moving too fast with negative consequences for patient care (26). The transfer of patients from NGO-run HIV specialty clinics to government facilities was not seamless, and one study showed that 18% of ART patients transferred from private HIV-specialized treatment to public primary health centers were lost to follow up during the transition (29). Another study revealed low satisfaction with the quality of care and responsiveness among patients transferred from a private facility to government clinics (30). The evidence of loss to follow-up during transfer and reduced satisfaction when HIV patients move from specialized private HIV clinics to government facilities is not unique to South Africa and has been seen in transitions in other settings in SSA, including the Democratic Republic of the Congo (31). Human resource capacity has also been affected. Whereas PEPFAR supported salaries and top-ups for government health workers and maintained community health workers prior to transition in South Africa, support has been discontinued without a plan for retaining staff (26).

PEPFAR's experience in Botswana has been similarly criticized for being too hasty and happening at a time when the goal of an AIDS-free Generation was being promoted (32). PEPFAR put support to Botswana on a "glide path" with funding declining from $75 million to $35 per year over a five-year period. PEPFAR had seconded 170 health professionals to HIV/AIDS agencies, at its peak. Bringing these positions into public service was hindered by a government hiring freeze (32).

PEPFAR's transition in the Eastern Caribbean differs from the experience in Southern Africa because HIV has a lower profile, with transmission concentrated among men who have sex with men (MSM) and commercial sex workers (CSWs). In addition, PEPFAR accounted for less than half of HIV funding in these countries (28). However, Vogus & Graff (2015) expressed concern about the sustainability of programs targeting KPs by governments that criminalize sex work and homosexuality once PEPFAR exits (28).

Concerns about the willingness of governments to continue work with key populations have been echoed in Mexico and in Eastern Europe as the Global Fund transitions out of many of these countries. In these settings, needle exchange and opiate substitution therapy programs for prevention among injecting drug users (IDU) have not been sustained, and, in Romania, IDUs have become a major source of new HIV infections (24).

India offers a counter-example where outreach to key populations was maintained by government during the early post-transition period. Among HIV transitions, the early experience of transitioning the Bill and Melinda Gates Foundation's Avahan initiative in India stands out as one of the most successful to date. Continued service delivery during and following the transition process as well as positive feedback from program managers were cited as positive outcomes. However, the quantity and timeliness of funding and stability of commodity supply were negatively affected in the transition, as were the experiences of some community members who had been pushed from specialized services to less welcoming government health centers (25). The design of Avahan with the explicit goal of transferring it to government may have been a factor in its relative success (24).

The experience of Avahan is notable because, like PEPFAR, it was funded with international donor assistance, relied on NGOs for service delivery, and targeted key populations (CSWs, MSM, Transgender, and PWID) who are traditionally marginalized. The financial and policy commitment of the Government of India was a considerable factor in the institutionalization of the initiative after transition (33). Bennett et al. (2015) identified other key elements of the transitions associated with its success: strong links between the project and local partners, continued post-transition monitoring and assistance, funding for transition activities, and an extended time-frame with opportunities for reflection and assessment (34). The Avahan experience also stands out for having a prospective evaluation plan in place before the transition began (35) while most evaluations of transitions are retrospective and post-hoc.

These recent HIV transition experiences offer some broad lessons. First, successful transitions take years and, while transition planning is vital, it is not always enough to guarantee a smooth outcome. Secondly, KPs may be neglected by national governments following transition. Thirdly, political will is a major component of the success of Avahan's transition in India and in the somewhat successful experience in South Africa and Botswana. Uganda's GP, while smaller in scope, is being planned on a 1-2 year timeline that may be overly ambitious.

While the GP explicitly avoids discontinuing services to KPs, it remains unclear whether there is adequate political commitment, much less sufficient resources, at national or local levels to sustain HIV services following transition were KP programming transitioned in Uganda.

The GP in Uganda is occurring within the context of declining international support for HIV. The experience will gauge how ready low-income countries are for even a minor transition, and assess the potential impacts of transition on the sustainability of HIV services. However, HIV programs have health system impacts that extend beyond HIV care. It is important to understand how transition will affect the health system more broadly.

1.5 Literature Review of HIV Program Impacts on Health Systems

Since the launch of PEPFAR, many have voiced concern about the effect that large disbursements for HIV care will have on health system performance in SSA. This review of the empirical literature addresses three domains in which HIV assistance has been hypothesized to affect health systems negatively or positively: through impacts on funding for system strengthening and for other diseases, through human resources, and through delivery of non-HIV services.

1.5.1 Impacts of International HIV Funding for other Diseases and Health Systems Strengthening

Since the PEPFAR program was announced, there has been concern that funding for a single-disease vertical health program would reduce donor funding for other disease concerns (36-39) and horizontal health system strengthening (HSS). However, the evidence to date suggest that, while health sector strengthening has declined as a share of assistance, the increase in health funding overall has been a rising tide that lifts all boats. Dieleman et al. (2016)

analyzed trends in publicly reported development assistance for health by health focus area and find that annual growth across all areas, but especially malaria and TB, was high during the period 2000–2009 when HIV expenditure increased and exceeded the growth in HIV funding in 2010–2015, when HIV funding growth slowed to 1.3%. Maternal and child health have had steady rates of funding growth (40). However, negative impacts on funding for other diseases have been seen. Among countries where TB, malaria, HIV/AIDS, and HSS are all major priorities, a rise in HIV funding was associated with reduced funding for malaria but not TB or HSS (41).

The growth in donor funding for health system strengthening (HSS) is less positive, although somewhat unclear due to the multiple data sources and definitions of HSS used. Using a broad definition, the share of international assistance for HSS[1] has declined from 62% of health aid in 1998 to 24% in 2007, but the nominal amount dedicated to this purpose has risen slightly (42). Much of the increase in HSS is directly due to vertical programs. PEPFAR itself has directed about 20% of its funding to “governance and systems,” which includes HSS and investments in laboratory and strategic information systems (43). A detailed analysis of expenditures by two PEPFAR implementing partners in Kenya for programs aimed at the prevention of mother to child transmission (PMTCT) show that “support to health system strengthening” increased from 12% to 33% of spending between 2005 and 2010 (44).

However, in spite of vertical programs’ contributions, health system strengthening seems to be falling behind in funding. Dieleman et al. (2016) find that annual growth in funding for “sector-wide approaches and health system strengthening”, including that channeled through

[1] Shiffman J, Berlan D, Hafner T (2009) include in HSS a broad set of classes included in the CRS dataset, including health policy and administration, medical education/training, research, basic health care, nutrition, infrastructure, health education, and human resources development.

disease-specific programs, was lower in 2000-2009, during the scale-up of HIV programs, than from 1990-2000. From 2010-2015, as annual growth in total DAH and HIV/AIDS funding slowed to roughly 1% per year, funding for the category of "sector-wide approaches and health system strengthening" declined by 2.3% per year. Overall, it seems that HIV-specific funding has brought additional resources to health system strengthening agendas, but may have pushed out other disease-specific donor funding (e.g. malaria) and been associated with a period of weakening growth in funding of HSS that has persisted (40). The lack of consistency across development assistance data sources is a major limitation.

The large donor outlays for health (of which HIV comprises a significant share) have the potential to discourage nations from investing in their own health systems. Lu et al. (2010) identifies that for each $1 of DAH channeled through LMIC governments, governments' own contributions to health decline by $0.43. Among low-income countries such as Uganda, the estimated reduction in government expenditure for each dollar of aid received is $0.32. However, funds channeled through the private sector are associated with increased government expenditure on health (45). Critics of Lu et al. have indicated that off-budget aid was not accounted for in the analysis. Including off-budget aid, van de Sijpe (2013) finds that the fungibility of aid for health is limited or non-existent (46). Dieleman, Graves, and Hanlon (2013) conducts a re-analysis of Lu et al. (2010) with updated and expanded data and taking into account on and off-budget aid, and find that aid remains fungible (47). While it is uncertain to what extent donor funding pushes out government funding, it is clear that in many low-income countries international HIV funding has outstripped government's contributions.

Specifically, in Uganda, DAH increased dramatically from 2003 to 2009, with PEPFAR support for HIV/AIDS being the primary driver. While the GoU increased its total funding and maintained its level of support as a share of government expenditure, donor-funding increased at a more rapid pace. The bulk of this DAH was allocated through project support that bypassed the national coordinating mechanism (i.e. the Sector Wide Approach) (48). Uganda's national health account in 2011/2012 put the share of public financing for health care at 9.6% (49) of total health expenditure, but estimates for 2013 place direct public funding at 19% and donor funds at 36%, with the remainder consisting of private spending (50).

In addition to being considerably larger than GoU contributions, DAH was not aligned to Uganda's national objectives. STI & HIV/AIDS comprised more than 65% of donor project support. By contrast, the share of project support for "support systems" and "Essential Clinical Care, IMCI & Mental Health" declined from 29% and 18% in 2003 to 7% and 4% in 2009, respectively. This allocation stood in direct contrast to the Ugandan government's Health Sector Strategic Plan (HSSP), which allocated 2% to HIV/AIDS, 65% to "support systems" and 21% to "essential care" (48). The misalignment of donor funding to national goals has had distortional impact within the health system.

1.5.2 Impacts of Donor HIV Funding on Human Resources for Health

The distortion can be seen in the allocation of human resources for health. The funding directed to HIV has had a strong impact on human resources for health, attracting many health workers to focus on the delivery of HIV/AIDS services, which has led to claims of an "internal brain-drain" with the potential to exacerbate the human resources crisis in Sub-Saharan Africa (51). Empirical research on the effects of HIV programs on HRH is limited. A review of 31 reported program evaluations identified multiple incidences of personnel migrating from other health service areas, from public to private facilities, and to NGOs and donor agencies (52). A survey of graduates of one health training institution in Uganda found that 51% worked for a HIV-related NGOs and 42% spent at least half of their time on HIV (51). The draw of higher salaries and better-equipped facilities has pulled many workers into HIV-focused health care or into NGO administration (53), and frequent trainings reduce workers' time spent with patients. An example of the impact training has on service delivery, a survey of health workers in a region of Tanzania with severe understaffing found that 44% of clinical staff were away at the time of the survey, and more than 46% of these were attending seminars, meetings, or on long-term training (54). In contrast to these negative impacts, it is important to remember that health workers themselves are a population affected by HIV/AIDS and their ability to access treatment has positive implications on the health sector (55).

1.5.3 Impact of Donor HIV Programs on non-HIV Service Delivery

PEPFAR's positive impact on HIV service delivery in Sub-Saharan Africa (SSA) and Uganda, in particular, is widely acknowledged (2, 56). However, the impact of PEPFAR and other vertical programs for HIV on non-HIV services remains unclear. Grépin (2012) performed a multi-country ecological analysis of donor health spending for HIV and MNCH outcomes in SSA. She found no significant associations between HIV aid and MNCH outcomes overall. However, in low human resource density countries, HIV funding per capita is associated with higher coverage of ANC4+ and skilled birth attendance. However, HIV funding per capita was also associated with lower coverage of 3rd dose of DPT and Polio vaccines, particularly in low human resource density countries (57). Chima & Franzini also find negative associations between HIV aid and immunization rates in an ecological analysis in Nigeria. Each $1 increase in health aid for HIV per capita is associated with a 0.08 percentage point decline in full immunization (58).

In contrast, Rasschaert, Pirard, Philips et al. (2011) find positive spill-overs for non-HIV services from health system strengthening investments made in Malawi and Ethiopia alongside increased provision of ART. Antenatal care, outpatient visits, and delivery attendance at health facilities in both countries increased from 2004/2005 to 2009 as ART scale-up was underway. Measles immunization coverage also increased (59). In a very different setting, the transition of ART patients to community-based primary health care clinics in Kwa Zulu-Natal resulted in increased use of PHC facilities by HIV-negative individuals. Upgrades of PHC facilities concomitant with the transfer of ART facilities may explain the increased use by HIV- community members; however, the authors cite the case as a potential example of “therapeutic citizenship”, where ART clients promote use of their source of care among members of their communities (60).

Kruk, Jakubowski, Rabkin, et al. (2015) conducted a survey of health facilities in Kenya and found that the presence of PMTCT and ART programs was associated with better pre- and postnatal care quality. However, the ability to infer a causal relationship from cross-sectional studies of this type is limited (61). Using multi-country longitudinal data from a network of private not for-profit providers, Kruk et al., (2012) found that facility deliveries to HIV-negative women, but not ANC care, increased along with the number of patients on ART (62).

In Zambia, a study of patient records in 39 purposively-selected facilities from 2004–2007 showed that facilities that scaled-up HIV services had increased immunization relative to those that didn’t, but no effect was seen for family planning or for antenatal care (63). Potter et al. (2008) found that compliance with national guidelines for syphilis testing in ANC increased more in clinics that had PMTCT research and treatment programs. The authors posit that research program investments in training and supplies may have spilled over to ANC clients not enrolled in research studies (64). Mutabazi JC, Zarowsky C, & Trottier H. (2017) conducted a review of the impact of PMTCT on other services. PMTCT has important backward linkages (through promoting ANC attendance and testing) and forward linkages (by encouraging HIV+ pregnant women to deliver in health facilities) to MNCH care. They found that there was not a consistent empirical, quantitative assessment of the effects of PMTCT on outcomes (65).

Studies conducted in Uganda have yielded results that are as contradictory as those conducted in other countries. In a study of six public clinics in Kampala where HIV services were being rapidly scaled up, there was an acceleration of service delivery for immunization, laboratory testing of malaria, and diagnosis of skin diseases but no change in ANC and injectable contraceptive provision (66). A nationwide, district-level analysis conducted by Luboga, Stover, Lim, et al. (2016) presented evidence that ART scale-up in Uganda in 2005–2010 was associated with lower growth in non-HIV services (67). A companion qualitative study conducted among district health officers in Uganda demonstrated the belief that the benefits of PEPFAR outweighed its harms, but that PEPFAR funding overemphasized HIV relative to other health conditions and burdened health workers (56). The findings of Luboga et al. (2016) are countered by Wollum et al. (2017), who examined a nationally-representative sample of health facilities in Uganda over the period 2007–2012. They could not identify an association between ART program existence, size, growth, or relative size and outpatient department (OPD) visits for non-HIV care (68).

Many previous studies have addressed the impact of HIV programs on HIV and non-HIV services (56-68), but relatively few have evaluated the effect of transitioning HIV programs on

HIV services (28, 30, 33, 69-75). Furthermore, I am aware of no previously published studies that have examined the effects of transition of an HIV program on non-HIV services. In Rwanda, Binagwaho, Kankindi, Kayirangwa, et al. (2016) note that HIV services increased in Rwanda while PEPFAR support was scaled-back and funding transitioned to a budget-support model (70) and Farmer, Nutt, Wagner, et al. (2013) report continued improvements in maternal, neonatal, and child health outcomes coincident with Rwanda's HIV program transition, but does not explore the association empirically (72).

1.6 Conceptual Model

In seeking to understand the potential effects of transition on health systems, I searched the literature for conceptual models of transition. I could not find any in the literature. Therefore, I sought to develop a rudimentary conceptual model of transition impacts on health systems based on the idea that donor programs introduce "distortions" to the health system, which transition modifies. An example of a distortion is the concentration of health workers in facilities that serve as delivery points for vertical programs, which attract workers through incentives, access to training, and better-equipped facilities. When donor support is lost, the distortion will also be affected by transition. The outcome of transition — i.e. whether the functions provided by donor programs are adopted, discarded, or modified and institutionalized into a national system — affects the transition outcome. This could result in incentives being lost, and the distribution of workers transferring back to the prior state. Or, if the incentives are institutionalized, workers could remain in these facilities. I developed a conceptual model of how transition outcomes are likely to be determined, as an interplay between the nature of support, the transition design and implementation, and the national context.

Drawing from the literature, I catalogued the impacts that donor programs, particularly HIV donor programs, have had on health systems. Using the WHO Health Systems Building Blocks framework, I organized these according to building block. For each health system distortion identified in the literature, I identified how it may be impacted by transition and rated its relevance to the PEPFAR GP in Uganda. For the health system distortions most relevant to the GP in Uganda, I applied the conceptual model using my own assumptions about probable transition outcomes in the context of PEPFAR and Uganda. Finally, I summarized my hypotheses about impacts of transition in Uganda in Table 3. Readers who are primarily interested in the empirical findings may want to skip to chapter 2.

1.6.1 Review of Conceptual Models of Indirect Health System Impacts

To further understand the potential effects of transition, I examined conceptual models of the impacts — intentional and unintentional — that GHIs have purported to have on health systems in LMICs. I searched the literature to identify conceptual models of GHIs' health system impacts. The search strategy is described in the Annex. Seven studies containing conceptual frameworks were identified (52, 76-81).

Bennett and Fairbank (2003) developed a conceptual framework for analyzing the potential "systemwide effects" of the Global Fund to Fight AIDS, TB, and Malaria (GFATM) (76). This conceptual framework was applied to three case studies of the Global Fund's impact in Benin, Malawi, and Ethiopia in Stillman and Bennett (2005) (77). Together these two studies present a wide range of unintended effects of Global Fund programs across domains of "stewardship", "resource development", "resource allocation", "financing', "service delivery" during the GFATM's early roll-out.

Biesma et al. (2009) conducted a review of the published literature on health system effects of HIV/AIDS programs (52). Their conceptual framework builds on that of Bennett and Fairbank (2003) and broadens it with additions from other prior work by Brugha (2008)(82) to apply to the operations of the three major global health initiatives for HIV: GFATM, the World Bank Multi-country AIDS Program (MAP) and PEPFAR. Biesma et al. (2009) organizes the impacts identified in the literature into “policy development” and “policy implementation” categories (52).

The conceptual model of Warren, Wyss, Shakarishvili et al. (2013) (78) further extends the work of Biesma et al. (2009). Noting that the framework of Biesma et al. (2009) does not cover the WHO health system framework building blocks of “Service Delivery”, “Technologies”, and “Information Systems” (except for M&E), the authors extend the framework and apply it to an assessment of funding for health system strengthening within a sample of Global Fund Round 8 grants. The use of the WHO’s Health System Framework is also seen in the review of health systems strengthening of HIV/AIDS programs conducted by Yu, Souteyrand, Banta, et al. (2008) (80).

Using a different approach, Oliveira Cruz and McPake (2010) used agent theory to assess the hypothetical effects that HIV/AIDS programs have on the financial and regulatory relationships between on health system actors at the macro level. Oliveira Cruz and McPake (2011) applied this conceptual framework to a case study of PEPFAR and GFATM in Uganda and highlight conflicts resulting from multiple principal-agent dynamics (81).

1.6.2 Synthesis of Impacts

I consolidated the system-level effects included in these seven conceptual frameworks into a single list. Indirect effects that were common across sources were combined. Health systems impacts that were largely intentional, such as health systems strengthening interventions, were removed, as I was only interested in unintended health system impacts. PEPFAR health system strengthening at the above-site levels (laboratory, commodity, pre-service training) are likely to remain in place during the PEPFAR GP, and therefore are not relevant in transition.

Each unintended impact was assigned to one of the six WHO health systems building blocks: "Governance", "Health workforce", "Financing", "Information", "Service Delivery", and "Medical Products" (83). The result is a set of 38 health systems impacts, each one of which is assigned to a row in Table 2. For each indirect impact described in blue, I have added my own thoughts on the potential effect of HIV program withdrawal on the impact and a ranking (Low, Moderate, High) on the relevance in the specific case of the PEPFAR GP with explanatory comments.

Table 2: Indirect Effects of HIV Programs – A Summary of the Literature & Extension to HIV Program Transition, with particular application to the PEPFAR GP in Uganda

Literature			Predicted Applications to Transition	
Program Function	**Indirect Effects**	**Citation**	**Potential Impact Under HIV Program Transition**	**Hypothesized Relevance to PEPFAR GP**
Governance				
Regulation of private sector providers	Regulatory challenges imposed by including private providers	(76)	Without PEPFAR to monitor quality, private providers who continue to provide HIV services will need to be more closely supervised by government.	Moderate: Private facilities may not receive oversight following transition.
Highly centralized decision-making in vertical programs	Workplans developed without local input were uninformed and not trusted by agencies. Decentralization processes were affected.	(76-78)	Vertical programs tend to be centralized, their removal could shift control to local levels	Moderate: The suddenness of PEPFAR GP will push central support SNUs to make decisions about resource allocation. However, they could avoid decisions, awaiting central decision-making.
Verticalization of service delivery	Increased vertical nature of programs	(52, 76)	Standalone facilities will likely be closed/integrated and the health system will become less vertically oriented. Already integrated services may shift focus away from HIV toward other health priorities.	High: Removal of incentives for vertical delivery may have multiple, unclear effects on services, including, potentially, a shift from HIV to non-HIV care.
Requests for policies that conflict with national policies, and micro-management funding decisions and program implementation	Caused a sense of loss of ownership, resulted in government changing or contradicting national policies	(52, 76, 77, 79)	Donor exit would reinforce national ownership, but it may just shift dependence to other donors; sustainability may be affected by lack of ownership. Policies may better align with national than with donor interests.	High: Districts and national policy-makers will need to decide how to support programs over which they previously had little control.
Donor expectations of policy plans	Resulted in "tokenism" in the creation of plans with unrealistic goals to meet donor requirements	(79)	Government incentives to produce tokenistic policy plans will decline, but may not be replaced with genuine efforts	Low: National level planning will remain in place
Demands on policy-makers time to engage in burdensome proposal development, project implementation, and project monitoring/reporting	Shifted public and private staff away from other uses	(52, 79)	Policy-makers may be able to shift time towards other activities	Low: Impact on national level will be limited as GFATM and PEPFAR national processes will remain in place. Impact on facilities and district may be moderate.
	Programs and NGOs best able to write proposals and monitor projects funded over those with best able to achieve results	(79)	Donor-requirements will leave, but skills and habits built may be retained and transition into other mechanisms. Funding may shift away from programs that could best write proposals and manage grants.	Low

	Funding provided for specific diseases would not have been used the same way if untied	Provision of tied funds did not align with national interests	(52, 77-79)	Donor exit would remove the explicit tie to diseases, but it would do so after a decade or more of historically high levels of funding	Low: In CSD, district government will have choice about whether to replace IP support or invest their funds in other ways
	Many new coordinating bodies created	Unwieldy groups and duplicative coordination organization	(52, 77, 78)	Removing donor-supported coordination and leave government as the primary or only actor in coordination	Low: PEPFAR will remain active in coordinating aid at all levels
	Multiple financing mechanisms used within and across programs, failure to harmonize through SWAps	Use of multiple financing channels dilutes accountability and places doubts about the sustainability of funding	(52, 77, 81)	Withdrawal reduces the number of mechanisms and increases sense of ownership, but also removes sources of external accountability. Public accountability becomes more critical.	Moderate: In CSD, the consolidation of accountability within MOH will matter
	Required participation of Civil Society	Did not remove barriers for participation of most marginalized groups	(79)	Civil Society involvement will diminish to whatever level of participation it is able to obtain without donor support; most marginalized groups will remain so	Low: National level civil society involvement will probably remain
	Donor-programs stimulated the growth of NGOs without strengthening regulation or accountability or building trust	Many "briefcase NGOs" came into existence with limited roots or experience and lack of trust from government	(52, 77)	Renegotiation of public-private partnership after more than a decade of working together with donor support may result in private sector exclusion or a new private-public partnership	High: Private HIV provision may be de-emphasized if government is the only actor left to support health sector. To the extent that other funding is available, non-governmental organizations may be able to remain active.
	Donor-facilitated coordination between ministries results in multi-sectoral approaches	Conflicts between ministries and coordinating bodies over control of resources hindered response	(52, 78)	Donor incentives for coordination will fade, which may allow other coordination models to emerge or for coordination to weaken	Low: GP is localized and national-level coordination support will remain
	Lack of clear, coordinated strategy for HSS to implement program	Various HS distortions not overcome in a systematic way	(77)	HSS has become an element of health programs, donor exit may undermine HSS or remove distortions to HSS	Low: removal of HSS in CS-SNU may affect quality of system
Health Workforce					
	Distribution of human resources between focal and non-focal areas, between public and private systems: Health workers drawn to donor-supported programs	Reduced HRH for other conditions, decreased availability on account of training demands	(52, 76, 79)	Incentives for HIV care will lessen, and health workers may filter back into other types of care or emigrate	High: Directly supported staff will probably be retrenched while other supported staff may be demotivated and/or decide to turnover
	Equity in distribution of resources across regions and levels of the health system	Disadvantage small facilities and rural areas (any areas where it is harder to provide services)	(76)	New equity issues will arise	High: PEPFAR GP targets low prevalence, sparsely populated districts that are already under-served with lower levels of PLHIV on treatment.
	Increased burden on workers in HIV care	Staff burnout and demotivation are possibilities	(52, 77)	Withdrawal will reduce workload only if services decline	Low: Workload to remain high if expectations are met

	GFATM investments will support clinical but not auxiliary staff	Higher burden on the staff for upkeep of health facilities that support HIV care	(79)	Forced cross-subsidization of HIV programs will end, but so too will support for HIV care, which may have had spill-over benefits. Overall, it may not matter.	Moderate: Loss of support for HIV staff will further increase burden on health sector
	Without a national strategy (as in Malawi), various actors at the national and sub-national levels developed policies to fill gaps that distort incentives	Hiring short-term staff at higher rates, top-ups, allowances using program moneys in an unbalanced way	(77)	If the incentives were distortional, withdrawal will remove distortion and a new equilibrium will be established.	High: Health workers losing incentives through PEPFAR will change employment and/or become demotivated.
	Large element of programs dedicated to in-service training on clinical skills	In-service training provides per diem income, but removes staff from clinical care	(52, 77, 78)	In-service training will be reduced, affecting skills for both the targeted and some non-targeted services, and affecting incomes of health workers.	Moderate: Loss of targeted disease-specific training may affect skill development more generally, leading to lower quality of care.
	Training and resources provided have impacts on non-focal services	Non-focal conditions benefit from shared training as well	(52, 77)	Reduced training may remove spillovers	Moderate: Access to training is likely to be affected.
Service Delivery					
	Integration across providers (coordination)	Donors support HIV referral systems that link public, PNFP, and PFP providers	(76)	Integration may breakdown without the support of donors	High: The HIV referral system may deteriorate, particularly if HIV services are consolidated to a smaller number of facilities or concentrated in the public sector
	Inclusion of private provider groups		(76)	Transitioned private providers may discontinue HIV care OR implement more cost-recovery from patients	Moderate: Low-volume and some large CS-SNU private providers will lose support
	Public/Private Provision	Private providers relied upon for service delivery without being incorporated in public financing or regulation	(76)	Withdrawal from private facilities may cause an exodus to remaining public facilities, unless the quality deterioration leads to the opposite process	High: HIV services may become concentrated in the public facilities. However, some may forgo care.
	Public/Private Provision	Support for public and private provision resulted in fragmentation and the need for coordination	(79)	Fragmentation may diminish if private providers exit HIV care, but it may increase if coordination cannot be achieved	Moderate: Loss of support by private providers could result in reduced provision, but the low-volume sites transitioned are of limited influence
	Donor-programs reinforced verticalization	Linkages between specific disease programs undermined by verticalization	(77)	Loss of incentives for verticalization may result in in integration of services	Moderate: Facilities and CS-SNU managers have decision of how best to organize HIV and non-HIV care in the post-transition landscape
Financing					
	Targeting investment to the highest returns (post-2008 reforms in Global Funds)	Targeting investments contrary to equity	(79)	Government priorities for resource allocation will replace GHI's efficiency-driven resource allocation strategies	Low: PEPFAR is targeting and remains in control of deciding where resources are invested.

	Past donor investments place hold on future budgets to maintain	May demand more government resources post transition	(76, 79)	Many investments (logistics, information systems, and facilities) require "central support" to continue to maintain them	Moderate: Budgetary response is likely to be delayed, but effects of lack of funding may be seen in 1-2 year project timeframe
	Additionality requirements	Funding exceeded budget limits set by GoU, thereby requiring that funding be provided off-budget	(79)	If funding was truly additional, replacing it would push budgets against macroeconomic limits	Low: Budgets unlikely to respond in the short-term, and changes in funding with GP likely to be small
	Funding not truly additional	Fungible funding (governments pull-back if not genuinely additional)	(76, 77)	Genuinely "additional" funding cannot be replaced after transition unless through new sources of revenues. If funding was not additional but was fungible, government will be able (but not necessarily willing) to transfer it back into health and HIV.	Moderate: Governments may choose to step up support to replace donors
	Donor-specific funding cycles, delays in disbursement, and year-to-year shifts in commitments, and lack of flexibility	Governments have difficulty budgeting for unreliable donor funding	(52)	Reduction in funding will simplify budgeting process, but also dramatically reduce total resources available	Low: PEPFAR funding cycles unaffected by GP
Information					
	Parallel logistic information systems created along with supply chains	Developing parallel systems for logistics	(76)	Fewer parallel systems, but what will become of the now strengthened logistic systems?	Low: Support for HMIS and logistics to remain in place
	Donors establish parallel service delivery M&E systems to bypass weak M&E	Duplication of reporting and capacity not built within the national government M&E	(52, 76, 77, 79)	Single M&E will be left, but it will not contain all the elements of the parallel M&E system, and the support and accountability attached to it is missing	Moderate: PEPFAR is leaving M&E support in place, but parallel systems will remain. Parallel systems are still actively used by PEPFAR in Uganda.
	Increase evidence-based planning	Donors provide a demand for strategic information as well as resources for M&E	(78)	Following exit, the use of M&E data for planning will be lost. Governments, without an incentive to use information for reporting, may not replace PEPFAR in evidence-based planning	Low: PEPFAR is as engaged in M&E as before, perhaps even more so.
	Increase accessibility of information	Donors produce SI that is available for government	(78)	Governments benefit from SI that donors support/produce. If transition results in less focus on SI, availability of information may suffer.	Low: PEPFAR is still supposed to be supporting SI everywhere.
Medical Products					
	Bypassing procurement systems	Capacity not built within the national government procurement systems	(77)	Support for national procurement will be discontinued with or without parallel systems	Low due to the retention of support for commodity systems
	Multiple sources resulted in differing levels of cost-recovery for commodities	Confusion and inequity	(77)	Public-private cost differential likely to increase as donor support to private sector wanes	Moderate: Larger private facilities may continue HIV services with more cost recovery

Footnotes: CS, central support; GFATM, Global Funds to Fight AIDS, TB, & Malaria; GHI, global health initiatives; GoU, government of Uganda; GP, geographic prioritization; HIV, human immunodeficiency virus ; HSS, health system strengthening; NGO, non-governmental organizations; M&E, monitoring & evaluation; PEPFAR, President's Emergency Plan for AIDS Relief; PNFP, private not for-profit; PFP, private for-profit; SI, strategic information; SNU, sub-national unit; SWAp, Sector-wide approach.

1.6.3 Conceptual Model of Health System Impacts of HIV Program Transition

The conceptual models identified in the literature address the potential impacts of GHIs on health systems, but they do not address how these impacts will change during transition. As noted previously, the impacts that HIV programs have on health systems will not simply reverse under transition. First, HIV program transitions tend to be piecemeal and sequential, and the PEPFAR GP only transitions site-level components. The context of the program transition also matters, as does the institutional framework and local context in which the transition is taking place.

HIV programs are composed of multiple components ranging from specific technical services provided through facilities (e.g. ART), to care for orphans and vulnerable children, or broad prevention campaigns (behavioral change communication). Differing components will likely have disparate outcomes under transition. In rare cases, HIV program activities will be adopted wholesale by governments and their functions will be sustained exactly as before, leaving the indirect impacts largely unchanged. However, it is more likely that the HIV program functions will either be performed by adapting existing national institutions or they will be scaled-back or discontinued entirely as systems revert to the pre-program status quo.

If the transition results in the discontinuation of an HIV program function, the distortional effect will also fade. For example, the GFATM encouraged civil society involvement in planning and coordination, often over the concerns of the public sector. Without GFATM support, civil society may not be included in such settings (discontinuation) with consequences for the health system (i.e., increased sense of government ownership but reduced civil society input in the HIV sector).

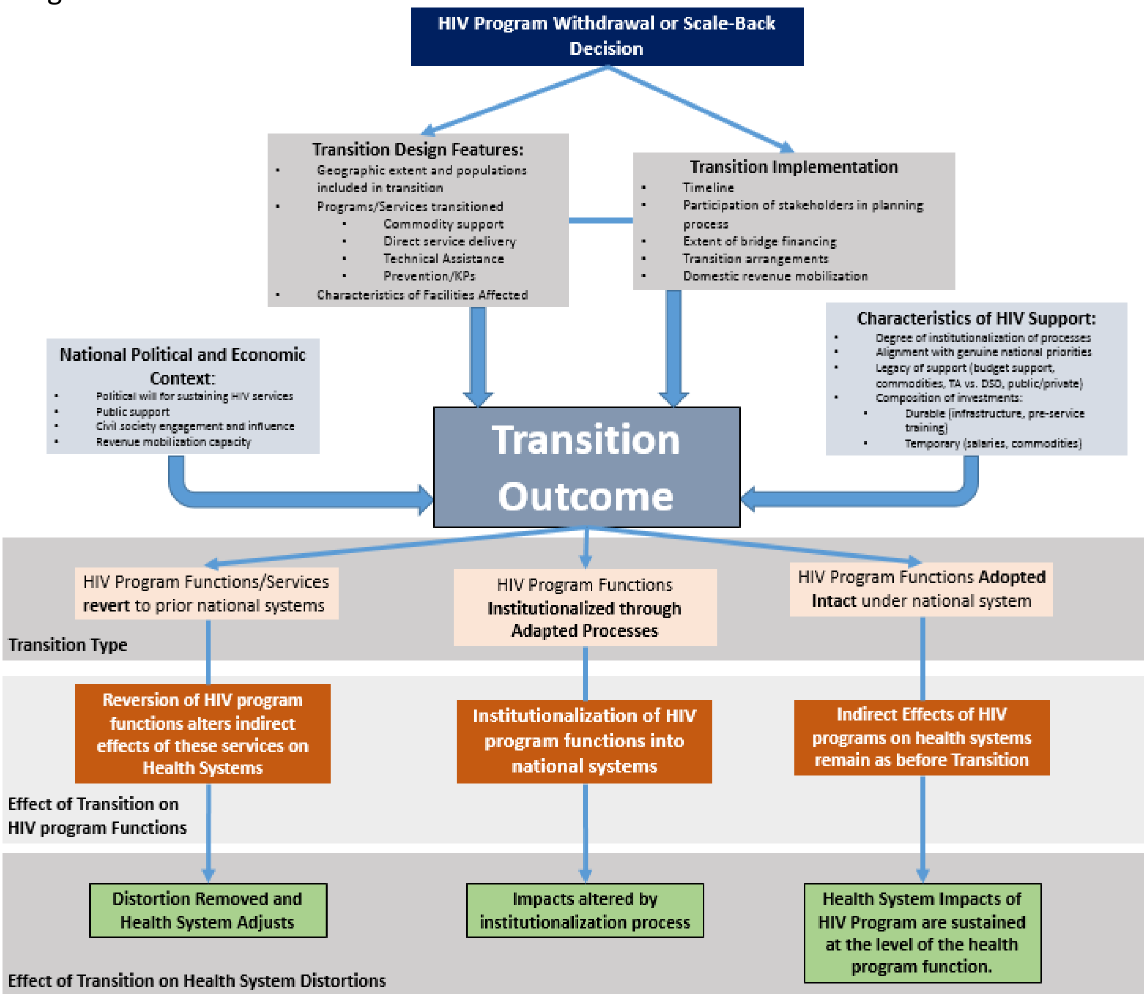
In many cases, the outcome of transition will be the institutionalization of a prior donor-supported activity into existing national systems. The outcome for the health system under such situations will depend on the specific details of the processes that perform the function once provided under the donor-supported HIV program. For example, if coordination now takes place through a single body rather than through multiple donor coordination mechanisms, the role of civil society will depend on the extent to which it can advocate for its own involvement in that consolidated body. Figure 3 seeks to capture this interplay between program transition and national institutions in determining if and how prior HIV program functions are sustained.

In Figure 3, the design and implementation of the program transition are jointly determined and influence the transition outcome, that is if and how prior HIV program functions will be sustained, together with local contacts and program characteristics. The transition outcome will determine how the original indirect effects of health systems are altered by the transition process.

The starting point for Figure 3 is the transition decision. Transition will have a specific design and implementation process, which will likely interact with and be altered by contextual factors related to the national political and economic context (e.g. degree of political support for HIV) as well as the characteristics of the preceding HIV program (e.g. alignment with national priorities, use of national health system for service delivery). These factors will interact to determine if and how each HIV function is transitioned (called here the "transition outcome"). HIV program functions (e.g. testing of high-risk groups) can be discontinued and the service will revert to whatever existed before the program, be adapted and institutionalized, or be adopted entirely with little change. Each outcome will have a different effect on the health system.

The conceptual model has some limitations and assumptions that should be noted. First, the transition decision is assumed to be exogenous. However, this is unlikely to be the case for most transitions that consider the context and probability of various transition outcomes prior to transitioning programs. Programs that are likely to have transition outcomes that are unfavorable to donors are less likely to be transitioned. However, this model is still useful to the Uganda GP, in which transition decisions were made based on PEPFAR/Uganda criteria according to guidelines set out by PEPFAR in Washington, D.C. with, what seems to have been, limited consultation with local stakeholders.

Figure 3: Conceptual Model for Assessing Health System Impacts during Transition of an HIV Program



Footnotes: DSD: direct service delivery; KP: key populations, TA: technical assistance.

1.6.4 Application of Conceptual Framework to the PEPFAR GP in Uganda

I predicted the changes in health system impacts listed in Table 2 during program transition using the conceptual framework outlined in Figure 3. As contextual factors are important in applying the conceptual framework, I limit the discussion to the health system impacts that are relevant to the PEPFAR GP in Uganda. Relevance is determined both by what is known of the transition process in Uganda and by the feasibility of measuring outcomes associated with the indirect impacts under transition. Not all potential impacts on health systems can be quantified with existing secondary or even primary data collection efforts. Moreover, as the transition outcomes in Uganda remain to be seen for many program functions, I included more than one plausible transition scenarios for some programs functions.

The primary indirect impacts of relevance to the GP in Uganda include Health Workforce/Distribution of workers between services and facilities, Health Workforce/Incentives and motivation, Health Workforce/Training, Service Delivery/Provider Integration, Service Delivery/Public-Private Provision mix, Service Delivery/Capacity & Utilization, Medical Products/Supply of commodities, Governance/Ownership, and Governance/Accountability. These indirect effects occur alongside the many direct effects resulting from the transition of PEPFAR programs.

However, not all of these impacts could be examined in by the parent study or addressed in the thesis. I will narrow the discussion of impacts to three domains: 1.) Health Workforce (Training, Incentives and motivation, Distribution), which I address in the first paper of this thesis; 2.) Service Delivery/Capacity & Utilization, which is addressed in the second paper; and 3.) Service Delivery/Public-Private Provision mix, which I study in the third paper.

Health Workforce

HIV programs have drawn a disproportionate share of health workers in Uganda, particularly among highly-trained cadres. The distribution of health workers following transition will be determined by the extent to which HIV care and the facilities providing it can retain staff relative to other services and facilities. This will be influenced by the loss of salaries and incentives (e.g., training, and per diems/bonuses) due to transition. It is unlikely that alternative funding will be available to replace these incentives in the short-run, but coping mechanisms can blunt the impact. Staff responsiveness to the loss of incentives will determine the extent to which maldistribution of staff created by PEPFAR incentives is adjusted. Such effects can be seen by tracking the number of each type of cadre employed by health facilities over time and through time-use surveys of health workers.

Among the direct effects of PEPFAR withdrawal, the loss of health worker incentives may not only influence the distribution of health workers but also directly reduce their motivation and productivity. Indirect impacts on health workers from transition, in the form of poorer working conditions and less support and training, may also affect motivation. Workers may seek alternative sources of income (e.g., informal payments or moonlighting) or their productivity may decline. Either response by health workers would negatively affect HIV service volume as well as any non-HIV services that they were providing. The consequence would be a decline in service provision per staff member. Alternatively, the loss of incentives for HIV could result in a switch from provision of HIV to non-HIV care.

Health Workforce/Training will be strongly affected by the transition through the discontinuation of PEPFAR support for trainings. The composition of trainings following transition will be determined by remaining actors, including government and other vertical projects for malaria, MNCH, TB, etc. Assuming that the HIV trainings aren't continued, or that workers cannot access them without PEPFAR support, there will be a direct impact on the quality of skills in HIV care within a few years, especially given rapidly-evolving HIV treatment guidelines. These trainings may have also improved the quality of non-HIV services. The long-term effect on quality of care would be difficult to measure, but some quality measures can be obtained from HMIS data.

Service Delivery

In the short-run, reduced training and meetings with PEPFAR IPs may result in more time for patients, resulting in higher delivery of services. Health workers are frequently absent due to meetings and trainings (54). In the long-run, loss of training and reduced coordination may have negative results.

Service Delivery/Capacity & Utilization can be affected through multiple channels. Changes in Health Workforce and Medical Products (i.e. drug stock-outs) domains could have secondary effects on the domain of Service Delivery. However, the GP could also lead to a loss of quality or accessibility of services that reduce utilization without having an impact on the supply of drugs. Facilities may decide to discontinue some HIV services and shift patients to other providers. For example, facilities could decide to cease provider-initiated testing, outreach testing, or ART default-tracing activities which would reduce use of related services. A shift towards provision of non-HIV care (potentially driven by a desire to seek incentives provided through other health programs) could lead to lower volume of HIV services being performed.

Public/Private Provision Mix will probably be affected by the PEPFAR GP, which will eliminate support to many private facilities with low-volume of HIV care. Without access to public sector resources, private providers will either cease to provide HIV care or use cost recovery to supplement support previously received through PEPFAR. Either scenario will likely result in fewer patients using private facilities for HIV care. Reduced private sector competition may alleviate fragmentation of services, but can also limit patient choice and access. The distribution of services between public and private facilities can be assessed, but the impacts of fragmentation and patient options are far more difficult to assess quantitatively.

1.6.5 Hypotheses of PEPFAR GP Impacts in Uganda

Table 3 summarizes the above discussion. For each impact, the outcome of transition (how transition adapts the HIV program functions) will have effects on measured quantities of service delivery and/or human resources. It can be seen that many different impacts influence service volume. For example, an increase in non-HIV services could be the result of an increased supply of health workers in non-HIV care resulting from transition, a decline in time spent in trainings, or time freed by a decline in HIV services. In the analysis proposed, the profile of human resources, HIV care, and non-HIV service delivery will be considered in conjunction to differentiate among hypotheses. There are also many unrelated factors that can confound the outcome in this non-experimental study, methods to address these factors will be discussed in each paper.

Where relevant, the anticipated short-term (<1 year) and long-term effects (≥1 year) are differentiated. In many cases, short-term effects are not expected. The exception is for loss of incentives that encourage HIV care relative to non-HIV care, which can shift provider behavior fairly rapidly. Loss of training opportunities will have an immediate benefit if it leaves providers more time for patient care. The same can be said about other demands placed on providers' time by PEPFAR (reporting, mentoring visits). However, in this case the long-term effects of less training and mentoring is a reduction in quality of HIV services. I have assumed that the effect will also spillover into lower quality of non-HIV care in the long-term.

Table 3: Possible Transition Processes and their hypothesized Health System Effects under the PEPFAR GP

Health System Domain	Impact	Possible Transition Outcomes	Mediating Factors	Expected Impacts		
				Human Resources	**HIV Service**	**Non-HIV Service**
Health Workforce	**Distribution**	Loss of incentives causes staff to leave transition facilities, remaining staff reorient focus to non-HIV care	Facility and Worker Coping Mechanisms	**Short-term:** No change in aggregate number of workers **Long-term:** Decline in workforce in transition facilities	**Short-term:** Decline in Volume **Long-term:** Reduced capacity – Decline in volume	**Short-term:** Increase in Volume **Long-term:** Ambiguous
	Motivation	Loss of Incentives results in less productivity (through absenteeism) or decline in responsiveness	Facility and Worker Coping Mechanisms	**Facility Survey:** working hours, absenteeism and motivation questions	**Short-term:** No change **Long-term:** Decline in Volume	**Short-term:** No change **Long-term:** Decline in Volume
	Training & Mentoring	Decline in frequency of HIV training and indirect effects on non-HIV skills	Trainings provided by government and others		**Short-term:** Increased Volume (more time available) **Long-term:** Decline in Quality	**Short-term:** Increased Volume (more time available) **Long-term:** Decline in Quality
Service Delivery	**Service Delivery/ Capacity & Utilization**	Discontinuation of HIV services in transitioned facilities	Government or facility commitment to maintaining HIV services	**Facility Survey:** Discontinuation of HIV Services	**Short-term & Long-term:** Decline in Volume	**Short-term & Long-term:** Ambiguous
		Access barriers or reduced attention to HIV services result in reduced utilization of HIV Services	Incentives to shift time to non-HIV care	**Facility Survey:** Reduced time on HIV & increased time on Non-HIV care	**Short & Long Term:** Decline in Volume	**Short & Long Term:** Increase in Volume
	Public/ Private Mix (PFPs & PNFPs)	Private facilities discontinue or seek cost recovery for HIV	Patients respond by shifting to public providers	**Facility Survey:** Reduced time on HIV care in PFPs and/or PNFPs	**Short & Long Term:** Reduced volume in PFPs and/or PNFPs	**Short & Long Term:** Ambiguous

Footnotes: HIV, human immunodeficiency virus; PEPFAR, President's Emergency Plan for AIDS Relief; PNFP, private not for-profit; PFP, private for-profit.

1.7 Research Questions & Methods

This thesis consists of three papers, each of which addresses a single, overarching research question. The papers outline effects of transition on 1.) Human resources for Health (HRH), 2.) Service delivery, and 3.) Differential impacts on public, PNFP, and PFP providers. In order to answer the questions raised in the three papers, I relied on the quantitative components of the parent study (Project SOAR, Geographic Prioritization Study) in Uganda. These include a cross-sectional facility survey and analysis of secondary data from DHIS2 and HRHIS.

Table *4* relates papers and objectives to data sources. I discussed the data source and data methods broadly in this introduction. Specific issues of data analysis are addressed in the individual papers.

Table 4: Dissertation Papers, Objectives, and Methods

Paper Theme	Research Question	Sub-Objectives	Data Sources
1.) HRH	**How does transition affect inputs to HRH and health worker outcomes?**	Summarize how transition changes site-level support for HRH	Facility Survey
		Measure the impacts on human resources in transitioned and maintained facilities in terms of termination of posts, numbers of staff, worker time-allocation, satisfaction, and motivation	Facility Survey & HRHIS
2.) Service Delivery	**What is the impact of transition on the availability, quality, and volume of HIV and non-HIV services?**	Impact of transition on HIV and non-HIV service availability	Facility Survey
		Impact of transition on patient access and service quality	Facility Survey
		Effect of transition on the volume of HIV and non-HIV services delivered	DHIS2
3.) Private Sector	**How do the impacts of transition differ by facility ownership?**	Identify disparate impacts of PEPFAR GP on health systems and human resources in transitioned private sector facilities	Facility Survey
		Identify how service delivery changes in PNFP and PFPs in response to transition from PEPFAR support	Facility Survey & DHIS2

Footnote: DHIS2, district health information system 2.0; HIV, human immunodeficiency virus; HRHIS, Human resources for health information system

1.7.1 The Parent Study: Mixed Methods Evaluations of PEPFAR GP in Kenya & Uganda

The broader study consisted of a mixed methods evaluation of the PEPFAR Geographic Prioritization in Kenya and Uganda. The study objectives and methods are presented in

Table 5, and these include document review & key informant interviews, facility survey and secondary data (DHIS2), and longitudinal case studies. The findings presented in this dissertation come exclusively from the facility survey and secondary data analysis. However, I did rely on information gleaned from other study methods in the discussion of the results.

Table 5: SOAR Study Overview

Objective	Methodology	Sample
Document GP implementation	Document review Key informant interviews: USG, Kenyan Ministry of Health, civil society, implementing partners (IPs)	23 interviews 2 rounds (May and November 2017)
Determine changes in key HIV and non-HIV service indicators associated with GP over a 3-year period (2014–2017)	Facility survey (May–July 2017) to track shifts in systems and service delivery Time series analysis of service outcomes based on extraction of DHIS2*(Oct 2013–Nov 2017)	230 facilities (7 central support counties and 3 maintenance facilities) 76–85 percent of central support and 91–95 percent of maintenance facilities
Explore changes in health systems as a result of GP and how this has affected HIV and non-HIV service delivery	Longitudinal case studies of selected facilities based on in-depth interviews with facility in-charges, county-level officials, and IP program officers	5 central support + 1 maintenance facilities 2 rounds (May and November 2017)

*District health information system

The facility survey was designed by researchers from the Department of International Health at Johns Hopkins, myself included, in consultation with local partners, including Makerere University School of Public Health. The survey instrument consists of eight sections: 1. Facility information; 2. Transition Arrangements; 3. Service Delivery, 4. Drugs, commodities, and laboratory support; 5. Supervision; 6. Human Resources; 7. Finance and budget, and 8. Individual worker questionnaires. The analyses presented in this study use indicators contained in sections 2, 3, 5, 6, and 8 of the survey as well as covariate data obtained from section 1, 2, & 6.

Survey interviews took a minimum of one hour to administer, but could extend over a single or multiple days in larger facilities. In small facilities (HC II, III, & Clinics) the facility in-charge or her acting replacement was used as the primary respondent. Respondents were allowed to seek information from other staff members. In large facilities (HC IV & Hospital), multiple respondents were used to obtain information, including the in-charge, directors of HIV clinic and maternity wards, the pharmacist, laboratory personnel, and the financial officer. In all facilities, 1–3 staff, including the primary respondent, involved in HIV services present on the day of the survey were randomly surveyed for section 8 (individual worker questionnaires). The individual respondents were asked about changes in time-allocation, non-salary support, job satisfaction, and motivation.

The sample contained 275 facilities with an expected non-response rate of 10% and a target sample size of 250. The sample size calculation is discussed in the annex to the introduction. I constructed the facility survey sample frame from a list supplied by USAID with designation of facilities as intended for either maintenance, scale-up, or transition in FY2015. I excluded all facilities identified for scale-up. From the sample frame, I selected survey units using a stratified random sampling design with three strata: 1.) 100% selection of all districts containing transitioning HC IVs and/or Hospitals as well as Kampala and Wakiso, which contain many transitioned PFPs, 2.) Random sampling of 11 out of 18 remaining districts that were designated as central support or maintenance districts, 3.) Random sampling of 6 out of 14 priority districts. Within all districts except Kampala and Wakiso, I sampled all facilities that were identified as maintenance or transition. In Kampala and Wakiso districts, I took a 40% random sample of transition facilities only.

Two facilities that were selected for longitudinal case studies that were also being conducted by the study but were not randomly selected for the facility survey — Amuru HC III

(Amuru District) and JB Clinic (Kampala City Council) — were purposively added to the survey sample, bringing the total sample size to 277.

The survey was fielded in July & August 2017 by enumerators hired by Makerere University. Enumerators were able to complete surveys at 262 facilities. Of the 15 facilities that could not be surveyed, nine had closed permanently, two were closed for construction, two facilities were identified as duplicate records, one (a PFP facility) refused to participate in the survey, and one was not accessible on account of hazardous road conditions. Ethical approval came from the Johns Hopkins Bloomberg School of Public Health Institutional Review Board (00007208) and local ethical approval was provided by the Uganda National Council for Science and Technology (SS 4263).

Secondary data came from two datasets: the district health information system 2.0 (DHIS2) and the human resources for health information system (HRHIS). The DHIS2 is an electronic web-based database for aggregating, managing, and displaying data collected from through the Health Management Information System (HMIS) in Uganda (84). The HMIS collects routinely generated data from health facilities and districts throughout Uganda relating to service provision, commodities, and health outcomes. The data used in this dissertation derive from two paper reporting forms submitted by health facilities: HMIS 105 & HMIS 106a. The HMIS 105 collects basic data on outpatient services related to acute events from health facilities on a monthly basis. The 106a collects outpatient data related to long-term follow-up of health conditions (e.g., HIV & TB) on a quarterly basis. In this study, I extracted data from DHIS2 for the period October 2013–December 2017.

The Human Resources for Health Information System (HRHIS) contains facility audit data, which consist of a real-time reporting of staffing levels for facilities (85). The data comes from the iHRIS platform, developed by IntraHealth, and is maintained by the Ugandan Ministry of Health Resource Center. The facility audits contain data on the number of approved and filled positions by cadre in reporting facilities. Reporting by facilities is incomplete for both DHIS2 and HRHIS datasets. Data is particularly rare for private for-profit facilities. I extracted HRHIS data on five occasions between April 2016 and December 2017. To extend the baseline, I use a dataset for December 2015 provided to the research team by IntraHealth.

1.7.2 Defining Transition – Official PEPFAR & Facility Self-Report

There are two different sources of information on past PEPFAR support and current transition status. The first is an official list of PEPFAR sites in FY2014 that identifies each site as transition/central support, maintenance, or scale-up. The list was provided to the study team by USAID in 2016 and represents transition intentions made in 2015. The second source is self-report by facilities, which is available for only for surveyed facilities, and represents transition status as of July–August 2017. In addition to asking about their transition status directly, the survey instrument asks facility in-charges about past support from PEPFAR IPs in the past three years overall and for specific forms of support (lab services, outreach, staff training, and supervision). If facilities received such support, the respondents were asked to identify when they stopped receiving it.

The USAID list of facilities that were targeted for transition differs considerably from facility self-report (Table 6). The percent agreement is only 54.2%. In particular, there are 68 facilities (26.0%) that were supposed to be maintenance but report transition in the facility survey. Most of these facilities were in a gap of support between IPs lasting for 9–12 months. The facilities lost support from Management Sciences for Health/Strengthening TB & AIDS

Response – Eastern Uganda (MSH/STAR-E), but had not yet received support from the Regional Health Integration to Enhance Services in Eastern Uganda (RHITES-E) project. The facilities report their experience as transition from PEPFAR support and exhibit similarities to other transitioned facilities. Therefore, I counted them as transitioned in the analysis of facility survey data. The maintenance facility sample size is reduced, and with it our power to detect significant differences between transition and maintenance has declined. Also, 36 facilities (13.8%) report no support from PEPFAR in the past three years.

Table 6: Comparison of Reporting Transition Status in Facility Survey Sample

PEPFAR Official Transition Designation	**Facility-Reported Transition Status**		
	Transition	**Maintenance**	**No Support**
Transition	**136 (51.9%)**	16 (6.1%)	34 (13.0%)
Maintenance	68 (26.0%)	**6 (2.3%)**	2 (0.8%)

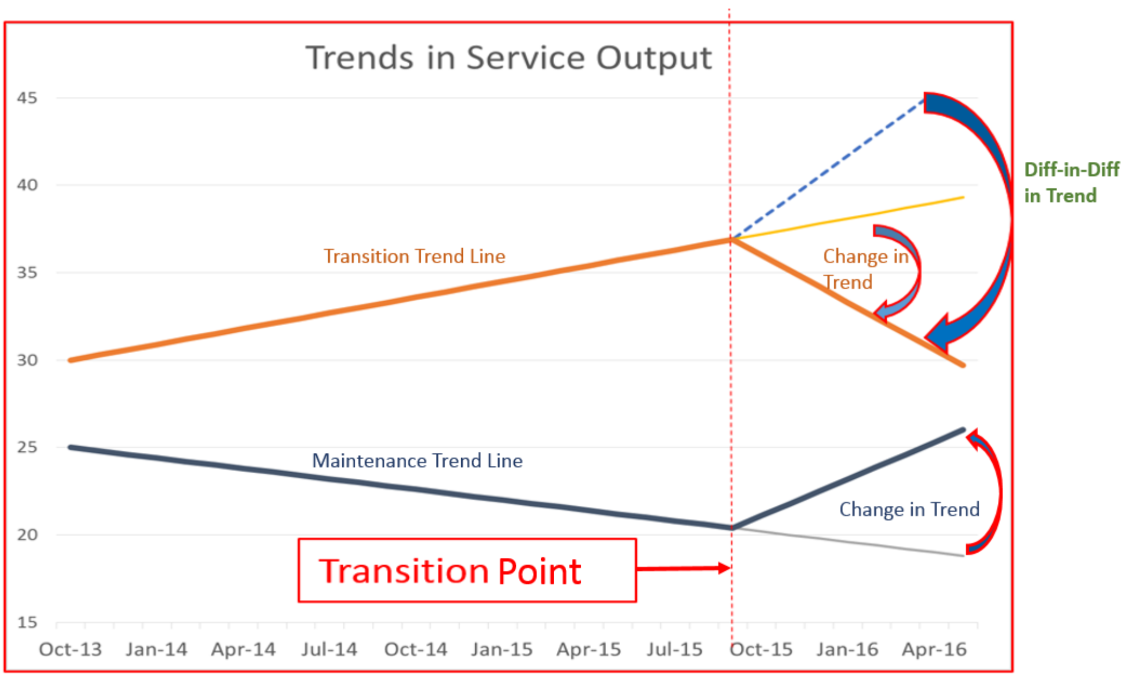
Footnotes: PEPFAR, President's Emergency Plan for AIDS Relief.

Given the discrepancies between sources, I used the official PEPFAR transition designation as an intention to treat (ITT) analysis. In secondary analyses, I examined the findings using facility-reported transition status among the survey sample. In the individual papers, I addressed the limitations of both analyses. This thesis does not attempt to define transition, rather I alternate between the official intentions and self-reported transition status of facilities in my analyses.

1.7.3 Modeling Transition Impacts

I used two methods to measure trends in services: difference-in-difference (D-in-D) and trend analysis. The D-in-D approach compares levels of services before and after a transition period for transition and maintenance facilities. The D-in-D approach comes with multiple assumptions, the most important of which for this study is the assumption of parallel baseline trends. I only used D-in-D approach for indicators for which baseline trends tend to be parallel, and I examine trends graphically in order to assess the validity of the assumption. Trend analysis compares the change in slope around a transition point for transition facilities relative to maintenance facilities (Figure 4). It is the preferred method for outcomes wherein baseline trends cannot be assumed to be parallel, which includes all count indicators. For all models using count data, I fitted mixed effect negative binomial regression models. For models with proportions or ratios, I assessed normality and fit Gaussian mixed effects models. Models are specified further in the Annex. The methods are discussed further in the individual papers.

Figure 4: Schematic of Difference-in-Differences in Trends (a.k.a. trend analysis)



1.8 Thesis Organization

The remainder of this thesis contains of three papers that address the issues of human resources, service delivery, and differential impacts on public and private facilities, respectively. The first paper addresses changing support to human resources and examines how health workers respond to transition. Having noted the human resources dimensions of transition, the second paper examines whether loss of PEPFAR support was associated with changes in service availability, quality, and volume. Having quantified the effect of transition on human resources and services, the third paper looks at ownership as a potential effect modifier of transition. Transition had different implications for private for-profit, private not for-profit, and public facilities and their responses to transition may differ. In the fifth and final chapter of this thesis, I summarized the results, compare the finding to my hypotheses, and discuss some of the lessons that can be drawn for policymakers, researchers, and implementers.

Chapter 2. "The Impact of Donor Transition on Human Resources for Health: Evidence from the PEPFAR Geographic Prioritization in Uganda"

2.1 Abstract

The President's Emergency Plan for AIDS Relief (PEPFAR) has had a substantial impact on human resources for health (HRH) in recipient countries. PEPFAR identified 734 facilities for transition in 2015–2016. There is limited prior evidence to suggest how human resources will fare following transition.

The Johns Hopkins University/Makerere University study team conducted a facility survey in mid-2017 that captured inputs to health workforce (salaries, incentives, training, and supervision) as well as health worker outcomes (termination of workers, changing time

allocation, job satisfaction, and motivation). Using facility-reported transition status, I compare responses for transitioned facilities to those maintained on PEPFAR using a weighted Chi-square test and an unweighted Fisher's exact test. In addition, we extracted data on staffing levels at publicly-owned health facilities from the Human Resources for Health Information System (HRHIS) for December 2015 to December 2017 and use a difference-in-difference analysis to compare staffing ratios for all workers and for nurses and midwives.

Of 226 PEPFAR-supported facilities surveyed, 206 reported transition. Compared to facilities that were maintained on PEPFAR support, transitioned facilities were more likely to have declining frequency of supervision for HIV (transition: 54.9% vs. maintenance: 9.2%; p<0.001) and declining incentives for outreach (95.3% vs. 25.4%; p<0.001) and "other" (airtime, food items, etc.) (94.1% vs. 13.5%; p<0.001). After loss of PEPFAR support, workers in transition facilities were significantly more likely to report decreased time spent on HIV care (32.1% vs. 11.2%; p=0.002), training (80.8% vs. 34.5%; p=0.005), reports (18.5% vs. 9.5%; p=0.023), meetings (39.2% vs. 6.0%; p<0.001), and administration (16.1% vs. 3.9%; p=0.028). Transition facilities were more likely to terminate HIV positions (25.7% vs. 0%; p=0.005), mostly those of lay health workers, such as HIV testing counselors and expert patients. However, trends in staffing levels for formal health worker cadres in public facilities did not differ significantly.

Transition negatively affected both inputs to HRH and some health workforce outcomes. Transitions of global health initiatives should take HRH impacts into account. In particular, donor-supported lay health workers are at risk of being lost during transition. Donors should work with governments to either shift workers to national systems or retain them through bridge support.

2.2 Introduction

Since their inception in the early 2000s, there has been an ongoing debate about the effects of global health initiatives (GHIs), such as PEPFAR and the Global Funds to Fight AIDS, TB, and Malaria (GFATM), on health systems and human resources for health (HRH). However, much of the early debate (prior to 2009) was characterized by a lack of evidence and reliance on anecdotal information (86). Since 2009, a number of studies have been published that sought to explore the connection between GHIs and HRH more broadly and with greater evidence. However, despite the growing pool of evidence, the subject remains unclear.

A number of studies have noted the large share of GHI spending going towards health system strengthening (43, 44, 87), with particular attention in recent years to above-site laboratory and information systems (87). Other studies have emphasized the human resources expansion that followed the introduction of GHIs. Cailhol, Craveiro, Madede, et al. (2013) note that, between 2004 and 2010, the density of health workers increased in four out of five high-HIV prevalence countries studied (88). Drawing on the experience of Malawi and Ethiopia, which expanded HRH during HIV scale-up, Rasschaert, Atun, Wouters, et al. (2011) present evidence that GHIs brought attention and funding to HRH and resulted in expansion of the health workforce as well as task-shifting models that allowed the health system to be more effective despite the added service volume associated with GHIs (59).

Much of the health system strengthening efforts made by GHIs have been directed toward training of health workers. Vujicic, Weber, Nikolic, et al. (2012) note that training of health workers is included in nearly all World Bank, GFATM, and GAVI grants, with the majority consisting of in-service training (89). In Uganda, district health officers (DHOs) credited training programs with improving HRH for both HIV and non-HIV services (56).

However, many articles rebut the claims that GHIs have only benefited HRH. Brugha et al. (2010) contrasted Malawi, which had an integrated human resources policy during HIV scale-up, with Zambia, where PEPFAR and the GFATM had uncoordinated HRH policies that increased workloads without increasing staff numbers (53). Uganda's DHOs also noted that, while PEPFAR's impact overall has been positive, there were negative impacts from increased workloads for HIV care and reporting requirements (56).

GHIs have also been accused of pulling clinicians out of routine health care into either specialized vertical programs or into administrative roles. This "internal brain drain" from the public sector has been cited by health system administrators in many countries, including Mozambique (90) and Uganda (56). In Uganda specifically, more than half of graduates from one of Uganda's medical schools worked in a HIV-related NGO and 42% reported spending "at least 50%" of their time on HIV (51). For comparison, it was estimated that HIV/AIDS contributed to 10% of Disability Adjusted Life Years (DALYs) lost in 2016 (91). Salary and incentive differentials, including access to trainings with generous per diems and travel reimbursements, have been cited as a cause of low morale among health workers in Uganda (56) and a source of conflict between workers in Zambia (92).

On funding, Fan, Tsai, Shroff et al. (2017) show that GFATM's "health system strengthening" (HSS) investments do not appear to be related to government effectiveness or health worker density, despite these being the very criteria that GFATM used in deciding whether to maintain or transition its support (93). At best, the authors argue that HSS funding is not driven by needs. Global Alliance for Vaccines and Immunization (GAVI) funding earmarked for HSS has been identified as largely consisting of supplies and health worker incentives, which do not result in long-term system strengthening (94). An analysis of GAVI, GFATM, and World Bank grants showed that health worker remuneration was included in more than 60% of GFATM and more than 50% of GAVI grants. However, in 69% of GAVI and 100% GFATM of these grants the sustainability strategy assumed that government or other actors would take over payments (89). These temporary incentives may distort HRH and render health systems less, rather than more, sustainable without external support.

Even for training there is disagreement about the benefits for HRH. Vujicic et al. (2012) note that, of studied GFATM grants, in 97% of cases where training was included, the training was disease-specific only (89). It is possible for disease-specific training to have spill-over benefits for non-targeted diseases, as noted by DHOs in Uganda (56), but it is less likely than for general training.

This is not to say that national health systems have been passive in response to GHIs. Health systems have been noted to respond to the burdens of HIV scale-up in a number of ways, including introducing their own health workforce incentives and through workload reduction policies, such as reducing frequency of visits for established ART patients (95). Task-shifting and expanded use of community health workers, including “expert patients” and peer educators, has been another common innovation (88, 95). Longer-term responses have included efforts to align salary scales and to share incentives between HIV and non-HIV workers (88) or to rotate clinical staff through positions with access to incentives (95). These coping mechanisms may have blunted the negative impact of GHIs, but they introduce new risks during transition, by relying on lay health workers funded by donors or increasing the number of workers that depend on incentives to supplement their salaries.

HRH policies and practices adopted during the scale-up of ART may not be suitable without donor support. In particular, the disorganized and uncoordinated expansion of lay HIV health worker cadres, such as “expert patients”, HIV testing counselors, peer mentors, and community health workers (CHWs) (hereafter referred to collectively as lay health workers) noted during HIV scale-up may make these cadres unsustainable following transition (96). National programs for lay health workers are often too weak and underfinanced to absorb and supervise the specialized HIV-trained lay health worker cadres employed by donor programs, and facilities may lack the budget to retain, train, and deploy these workers without donor funding.

In one of the few studies to examine the effects of transition on HRH, Cairney LI, Kapilashrami A. (2014) note that recruitment and retention strategies used during HIV scale-up in Namibia were not feasible following PEPFAR and GFATM’s scale-down. GHI programs in Namibia led to an increased hiring of health workers using a private recruitment firm at salaries that were higher than those offered by the MOH. The GFATM opted to cut its staff salaries by half, driving many to seek alternative employment. When both PEPFAR and the GFATM abruptly decided to cut back support in 2011, there was no transition plan in place. Government personnel management processes for creating new posts within the MoH, which require Cabinet approval, were slow to respond to transition (97).

Given the continued debate about the legacy of HSS by GHIs and the limited research conducted to date on transition, there is uncertainty about how transition might influence HRH. Only one study explicitly explores the effect of donor scale-back on HRH and only at a high level (97). Empirical studies are needed in order to shed light on the impact of transition. Also, by examining what happens when donors exit, these studies may reveal ways in which GHIs have distorted the HRH systems when they were present.

In order to target PEPFAR resources to regions with high unmet HIV needs, PEPFAR launched the Geographic Prioritization (GP) in the 2016 fiscal year across all 15 "long-term strategy" countries. "Long-term strategy" is a category of country that, under PEPFAR FY2014 Guidance, is characterized by high need for external support, high HIV prevalence, and limited domestic financial resources (14). In Uganda, the GP included both regional and low-volume facility components. Ten districts in Northeastern Uganda, including 94 facilities as well as another 640 more facilities identified as "low-volume" by PEPFAR were targeted to shift to "central support" through the GP (17). Transition of these facilities from site-level support was intended to take place by October 2016, according to PEPFAR documents (4).

Geographic Prioritization resulted in 734 health facilities being identified by PEPFAR for transition, thereby losing site-level support from PEPFAR IPs in Uganda. In parallel, contract terminations, re-distribution of regional programming to single IPs, and a shift from HIV-specific to integrated health system programming have been ongoing over the period (98), and may have resulted in additional facilities losing IP support.

PEPFAR IP site-level support comes in many forms, including supervision, training, salaries and bonuses/top-ups for health workers, outreach allowances, laboratory supplies and technical assistance, data quality support, and transport of commodities and lab samples. Many of the forms of IP support lost in transition went to strengthening HRH. The loss of support may impact health worker's skills and morale, which can influence their productivity and quality of care. Loss of salaries can result in terminations, while lost incentives may lead workers in transition facilities to seek employment elsewhere. The evidence base for transition's impact on HRH is incomplete at best.

2.2.1 Objectives

The objective of this paper is to understand how transition from PEPFAR support in Uganda affected site-level support for HRH and how facilities and health workers respond to transition in terms of HRH. There are two sub-objectives. First, I seek to summarize how transition changes the support that facilities receive from all sources for supervision, salaries, incentives, training, and laboratory. Secondly, I explore changes in human resources in transitioned and maintained facilities in terms of termination of posts, worker time-allocation, job satisfaction, and motivation.

This study relies on two key hypotheses. First, that PEPFAR IPs will withdraw support for HRH, and other actors — MoH, DHOs, health facilities themselves — will not fill all the resulting gaps. Secondly, that health workers will be aware of, and responsive to, the loss of support, and that some will respond by voluntarily transferring to other facilities, resulting in lower staffing, or by becoming demotivated and unsatisfied. Health facilities may also involuntarily terminate workers as a result of transition.

2.3 Methods

To understand the impacts of transition on HRH, I am using both a primary facility survey and a secondary dataset.

2.3.1 Facility Survey – Data Source

The study team fielded a cross-sectional survey of 262 facilities in 28 selected districts in Northern, Eastern, and Central Uganda in July–August 2017. The survey used a sample frame of PEPFAR-supported facilities in 42 districts across Northern, Eastern, and Central Uganda. We limited the sample to facilities that had been identified as supported by an implementing partner contracted to the United States Agency for International Development (USAID), per requirements from the funder. We selected district-level clusters of facilities using three approaches: (1) 100% selection of all districts containing transitioning health center IVs and/or Hospitals as well as Kampala and Wakiso districts, 2) random sampling of 11 out of 18 remaining districts that were designated as central support or maintenance districts, and 3) random sampling of 6 out of 14 priority districts. In sampled districts, we sampled all USAID IP-supported transition and maintenance facilities, except for in Kampala and Wakiso districts, where we sample 40% of USAID IP-supported transition facilities only. Two facilities that were case study sites for the parent study, but were not included in other sampling approaches, were purposively added to the survey sample. The survey sample is not nationally representative for all PEPFAR facilities in Uganda.

Survey enumerators asked facility in-charges about current and pre-transition access to trainings, supervision for HIV and MNCH services, salary support, and staffing patterns in their facilities. Additionally, in each facility, we sought 1–3 health workers involved in HIV to respond to a short questionnaire asking about the worker's non-salary support, time-allocation, motivation, and job satisfaction. As 36 facilities reported having no PEPFAR support in the past three years, we excluded them from the analysis. The final sample included 226 facilities that had reported receiving PEPFAR support during the past three years, 206 of which reported transition and 20 of which reported maintenance of PEPFAR support. We also collected at total of 479 individual interviews.

Analysis of the facility survey accounts for survey design using sampling weights, clustering at the district level, stratification, and finite population correction. For outcomes reported by workers, I also include adjustment for clustering of workers at the facility level. All analysis was performed using Stata 15 (99).

2.3.2 Facility Survey – Outcomes & Analysis

The facility survey findings from the in-charge and worker modules contribute to both sub-objectives (Table 7). To assess the impact of transition on inputs to HRH, I use the following outcomes: 1) Loss of PEPFAR IP support for Outreach, Training, Laboratory, & Supervision; 2) Change in Frequency of HIV and MNCH Supervision; 3) Changes in Salaries from PEPFAR IP, by cadre; 4) Changes in Non-Salary support for Bonus/Top-Ups, Outreach Allowances, and "Other" (which mostly consists of mobile airtime, transition allowances, and food items). For these outcomes, I conduct bivariate analysis only. Given the retrospective comparison included in these outcomes — changes in support since prior to transition – the analysis controls for fixed facility characteristics. I include supervision and training for maternal, neonatal, and child health (MNCH) as well as for HIV because supportive supervision visits can address both, and supervision and training can support quality of care and health worker morale even when not targeted to HIV.

For categorical outcomes, I performed a weighted Chi-square test comparing maintenance and transition facilities. As many unweighted contingency tables have cells with 5 or fewer observations, the Chi-square test is not reliable in all cases. I used the unweighted Fisher's exact test to check the results. For the proportion of workers with salary from the IP, I used a mixed effects logistic binomial model to provide inference on the difference-in-difference in salary support for transition relative to maintenance facilities. I included the stratification variables in fixed effects portion of the model and account for clustering at both the district and facility levels, in accordance with the principle of model-based analysis of survey data.

In order to assess how health facilities and workers respond to transition, I examined the outcomes of 1) Termination of HIV-related posts, 2) Changes in worker time-allocation since transition, 3) Changes in job satisfaction, and 4) Current motivation, measured through a 10-item index created by Mbindyo et al. (100). In the analysis, I compared the change in transition facilities to the changes in maintenance facilities.

For the outcomes of training, motivation, and job satisfaction, I only had cross-sectional information with no pre-transition baseline. Access to training can vary considerably by level, size, and ownership of facilities. To address these issues, I performed a multivariate regression analysis of the number of HIV training days per HIV worker per year since transition, adjusting for facility level, ownership, number of HIV workers, and district characteristics (whether or not the district was transitioned in whole to central support and whether or not the district was created since 2007). The annualized number of HIV training days is highly non-Gaussian. Therefore, I used bootstrap resampling to construct an empirical distribution with 10,000 permutations. As there were no significant differences in current job satisfaction or motivation scores by transition status, I did not present multivariate analysis for these outcomes.

Table 7: Objectives, Outcomes, and Data Sources

Objectives	**Outcomes**	**Data Source**	**Transition Indicator Source**
Summarize how transition changes site-level support for HRH	• Forms of Support Transitioned (Outreach, Training, Supervision, and Laboratory) • Supervision (for HIV/MNCH) • Salaries from PEPFAR IP • In-charge Perception on training • Reported Training (Any/HIV-related)	Facility Survey – In-charge Modules	Facility Self-Report
	• Top-Ups/Bonuses • Outreach Allowances • Other Non-Salary Support	Facility Survey – Worker Module	Facility Self-Report
Explore changes in human resources in transitioned and maintained facilities	• Terminations of Posts	Facility Survey – In-charge Modules	Facility Self-Report
	• Changes in worker time-allocation • Change in Job Satisfaction • Motivation	Facility Survey – Worker Module	Facility Self-Report
	• Staffing ratios for formal cadres	HRHIS (public only)	Facility Self-Report & PEPFAR GP List

Footnotes: GP, geographic prioritization; HIV, human immunodeficiency virus; HRH, human resources for health; HRHIS, human resources for health information system; IP, implementing partners; PEPFAR, President's Emergency Plan for AIDS Relief.

2.3.3 Human Resources for Health Information System – Data Sources

I hypothesize that facilities transitioned from PEPFAR will lose staff as a result of termination, reassignment, and voluntary turnover of health workers. The research team sought to measure the effects on staffing directly through the facility survey by collecting data on terminations and turnover. However, this survey captures only a portion of the national picture and relies on retrospective reporting by in-charges. Therefore, I also used secondary data on staffing levels from Uganda's Human Resources for Health Information System (HRHIS). The system is based on the iHRIS platform developed by Intrahealth/Capacity Plus and managed by the Ministry of Health of Uganda (101). The HRHIS dataset includes facility audits, which are counts of workers of each cadre employed by specified health facilities.

The HRHIS Facility Audit data does not have full coverage in Uganda. There is less reporting by private not for-profits (PNFPs) and almost none by private for-profit (PFPs). Moreover, PNFPs do not staff according to the same template that public facilities follow in Uganda. Therefore, it would be difficult to compare ratios of filled-to-approved positions for the PNFP facilities to public facilities. By contrast, public facilities have guidelines for staffing by level (Table 8) (102). This allows estimation of a staffing ratio, i.e. the ratio of filled to allowed positions. Therefore, I have restricted the HRHIS sample to public facilities only, of which there are roughly 1,500 PEPFAR-supported facilities that consistently report to HRHIS (Table 9).

Table 8: Typical (Approved) Staff Positions by Facility Type (Public Only)

	Health Centre II	**Health Centre III**	**Health Centre IV**	**General Hospital**
Number of Staff by Cadre for Each Public Facility Level:				
Nursing & Midwife Cadres	2	6	12	101
Nurse Assistant	2	3	5	15
Allied Health Professionals (Clinical Officers, Laboratory)	1	5	19	28
Medical, Dental, Pharmacist			2	8
Other (e.g. administrative, support, custodial, transport, security)	4	5	12	33
Total (All Cadre)	9	19	50	185

Source: Approved staffing Norms at Various Levels. Kampala, Uganda: Ministry of Health; 2014.

In this analysis, I used two aggregated counts of health workers: "All cadre" — which includes all health worker cadres recognized by the MoH — and "Nurses/Midwives" — which includes several cadres of enrolled nurses & midwives, nursing or midwifery officers, but excludes nurse assistants. Both aggregates exclude lay health workers, such as VCT counselors, expert patients, peer educators, and community health workers (CHWs). I included the nurse/midwife cadre for two reasons. First, they are supposed to be present at all levels of public health facilities, and, secondly, because they provide and/or supervise the bulk of MNCH and HIV care at health facilities. While a facility typically must have a clinical officer in order to offer ART, nurses & midwives are involved in HIV patient care through oversight of HTC and PMTCT and clinical examinations of ART patients.

I first extracted data from the HRHIS Facility Audit database on April 19th, 2016. To extend the baseline, I used a dataset provided by Intrahealth that goes back to December 2015 (Intrahealth, personal communication, November 06, 2017). This data was used to create the Human Resources for Health Audit Report 2015 (103), which was identified as representing the situation as of Dec 31, 2015. As many facilities likely transitioned before December 2015, this is not a genuine baseline. In our facility survey sample, 29% of facilities (unweighted) transitioned in 2015 or before. However, as I expected that staffing changes will be both immediate (e.g., resulting from loss of workers paid by PEPFAR IPs) and delayed (turnover of staff due to shifts in incentives and morale), I may still be able to capture the latter type using only post-transition data. The final data extraction took place in December 2017. This provides a 23-month follow-up period (Table 9).

Table 9: HRHIS Data Extraction Timeline & Counts

Data Source	Calendar Date	Months Since Baseline Data	Number of Reporting PEPFAR-Supported Government Facilities (% Coverage)
Human Resources for Health Audit Report	Dec 31, 2015	0	1,496 (78.9%)
HRHIS Dataset	April 19, 2016	3	1,520 (80.1%)
	Oct 2, 2016	9	1,496 (78.9%)
	Jan 19, 2017	12	1,507 (79.4%)
	May 5, 2017	16	1,503 (79.2%)
	August 19, 2017	19	1,494 (78.8%)
	Dec 14, 2017	23	1,491 (78.6%)

Footnote: HRHIS, Human Resources for Health Information System; PEPFAR, President's Emergency Plan for AIDS Relief.

2.3.4 HRHIS Data - Analysis

I merged HRHIS data to the 2015 list of 2,538 PEPFAR-supported facilities provided by USAID. As Uganda lacks unique facility identifiers, I developed a matching key for merging facility data using facility names. Only facilities listed as being publicly-owned according to PEPFAR datasets were retained. The resulting longitudinal dataset is described in Table 9, which outlines the reporting rate for government-owned facilities with PEPFAR support at baseline. Data coverage is consistent over time (Table 9); therefore, I only used the first and last observations in the statistical analysis as proxies for the pre- and post-transition situation, respectively. Lacking data on transition status for facilities not in the survey sample, I instead used USAID's classification. Therefore, the primary analysis of HRHIS data should be considered as an intention to treat (ITT) analysis.

Given the discrepancies between the USAID list and facility self-report noted in the introduction, I conducted a secondary analysis of HRHIS staffing data using the much smaller facility survey sample with self-reported transition status. As there is only one maintenance facility in the survey sample in Eastern Uganda and no facilities with data in Central Uganda, I omit regional interactions from the analysis, and include region only as Northern vs. Eastern.

Otherwise the analysis of HRHIS data using the facility survey sample is the same as described below.

In the analysis, I included any facility reporting in either December 2015 or December 2017. To address missing, I used a multi-level random intercepts model that is robust to missing under the missing at random (MAR) assumption. Essentially, I assume that missingness is not correlated with the outcome variable, i.e. the staffing ratio. This assumption requires that understaffing does not influence reporting to HRHIS, which is questionable. However, this assumption is less restrictive than the missing completely at random assumption that is required for other modeling approaches, such as complete case analysis, to yield unbiased results.

The multi-level model controls for autocorrelation of staffing levels within facility. I have allowed for random intercepts in staffing levels by facility, which induces an exchangeable correlation structure. As an exchangeable structure may not be appropriate for the data, I included a Huber-White Sandwich estimator to update the autocorrelation model using the data. In the fixed effects portion of the model, I included facility level, region, and transition status to account for some of the systematic differences between facilities in order to improve the validity of the assumption of normally distributed random intercepts. I controlled for potential confounding by including interactions of facility level and region with the post-transition dummy. Using difference-in-difference (D-in-D) analysis, it is possible to control for secular changes in staffing unrelated to the PEPFAR GP. The 2017 Ugandan fiscal year (July 2016–June 2017) was associated with a major increase in the national health budget and a rise in staffing levels. This national-level policy shift may have had regionally heterogeneous effects. Figure 29 (Annex) shows that staffing ratio increased most in all of Uganda except Central. Figure 30 shows weak evidence for differential changes in staffing by level of facility. Similar findings suggested of confounding exist for staffing ratios of nurses & midwives (Annex: Figure 33 & Figure 34).

I also controlled for facility upgrades during the study period. I identified facility upgrades from name changes over time. I confirmed the change in facility level by consulting DHIS2 records. As of December 14, 2017, 60 facilities in the sample had been upgraded since 2015. Facility upgrades occur as a result of district-splitting and the conversion of a HC IV into a district hospital as well as through selective upgrading of lower level facilities. Often facilities can also be upgraded from HC II to HC III in order to post a clinical officer to the facility and allow it to provide ART. I used the upgraded level of the facility in the analysis. Changes in level of facility affects the staffing ratio because newly upgraded facilities often cannot achieve the staffing norm for their new level immediately and consequently appear particularly understaffed after being upgraded. This understaffing can persist for many years.

The staffing ratios are fairly normally distributed, as shown in Figure 31 (and for nurses & midwives in Annex: Figure 32). Therefore, I opted to use Gaussian standard errors. Inference about transition's effect comes from the coefficient on the interaction term between time-dummies and the PEPFAR transition dummy. The full model is presented in the Annex. Essentially, the model tells us how different the change in staffing ratios was from baseline for facilities transitioned from PEPFAR relative to facilities maintained on PEPFAR, with some models controlling for level x time & region x time interactions. I hypothesized that the change in staffing at transitioned facilities will be smaller than that taking place in maintained facilities, representing a reduced ability to recruit and/or retain staff at health facilities following transition.

In order to interpret the effect estimates from D-in-D analysis as causal, I must be able to make three assumptions about the data: 1) parallel baseline trends, 2) that exposure to transition is not determined on the baseline trend in the outcome (i.e. the staffing ratio), and 3) independence of units. The data suggest parallel trends, but transition facilities have lower staffing and facilities selected for “low-volume” transition may well be low-volume due to understaffing. Also, I assumed that staff will leave transition facilities in favor of facilities that continue to receive PEPFAR support (i.e. maintenance or scale-up), thereby violating the assumption of independence. Therefore, one should be cautious in interpreting the effect estimates as causal effects of transition on staffing ratios.

2.4 Results

2.4.1 Facility Survey Results

Of the 226 survey facilities with PEPFAR support, 206 reported transition and 20 reported maintenance on PEPFAR (Table 10). The composition of facilities differed considerably between maintenance and transition. A higher proportion of HC III and a lower proportion of HC IVs and Hospitals reported transition from PEPFAR. A similar proportion of private facilities and public facilities report transition, but more PFP facilities report transition. The majority of facilities in transition and maintenance offer ART and deliveries. There were few notable differences in the types of support received from PEPFAR before transition, with the exception of training, which was reported by 91% of transition facilities vs. 70% of maintenance facilities. Nearly all transition facilities reported loss of all IP support while no maintenance facilities did.

Table 10: Descriptive Statistics of Survey Facilities (Unweighted)

	Transition (N = 206)	Maintenance (N = 20)
Level	**N (%)**	**N (%)**
HC II/Clinic	50 (24%)	6 (30%)
HC III	133 (65%)	10 (50%)
HC IV	14 (7%)	1 (5%)
Hospital	9 (4%)	3 (15%)
Owner		
Public	145 (70%)	14 (70%)
Private Not for-Profit (PNFP)	29 (14%)	5 (25%)
Private for-Profit (PFP)	32 (16%)	1 (5%)
Services		
Offers ART	152 (74%)	16 (80%)
Offers Deliveries	176 (85%)	17 (85%)
District		
Central Support	66 (32%)	8 (40%)
New District	31 (15%)	0 (0%)
Types of Baseline Support from the IP		
Supervision	190 (92%)	17 (85%)
Training	188 (91%)	14 (70%)
Outreach	161 (78%)	16 (80%)
Laboratory	177 (86%)	16 (80%)
Loss of Support from IP (% losing support/supported at baseline)		
Supervision	176 (93%)	0 (0%)
Training	176 (94%)	0 (0%)
Outreach	158 (98%)	0 (0%)
Laboratory	167 (94%)	0 (0%)

Footnote: ART, antiretroviral therapy; IP, implementing partner.

Among facilities reporting having supervision from any source, transition facilities are significantly more likely to report reduced frequency of supervision for HIV since transition (Table 11). However, the difference for MNCH supervision was not significant at a 5% level. Transition facilities were also significantly less likely to report having had any workers attend any training since transition. The unadjusted difference in the mean number of HIV training days per capita per year since transition is 2.64 days higher in maintenance facilities. This unadjusted difference is not significant using bootstrap standard errors (p=0.099). In a separate survey question asked only to transition facilities, 77.1% (95% C.I.: 72.6%, 81.0%) of transition facility in-charges reported “inability to attend trainings” as an effect of transition.

Excluding posts that were terminated or vacant at the time of the survey, the proportion of *currently filled* posts in the HIV workforce with salary paid by IP has declined from 6.0% to 0.5% in transition facilities compared to 5.1% to 2.6% in maintenance. The unadjusted difference-in-difference using a Gaussian regression model is 3.4 percentage points, and it is statistically significant. In other words, the decline in salary support was 3.4 percentage points greater for transition than for maintenance. Using a more valid binomial logistic model, the interaction of transition and post is associated with 0.141 times the odds of having a worker supported by the PEPFAR IP, but the finding is not statistically significant at the 5% level. The full model results are included in the Annex (Table 43).

In regards to non-salary support, only 13.6% of transition workers and 2.3% of maintenance workers report having had any baseline bonus or top-up support from PEPFAR IP. Nearly all bonus support has been reported to have decreased or discontinued. By contrast, 42.1% of transition and 32.1% of maintenance workers reported receiving outreach allowances at baseline, and among workers with outreach support at baseline, 95.3% of transition workers reported a decline or discontinuation vs. only 25.4% of maintenance workers ($p<0.001$).

A total of 23.9% and 16.7% of transition and maintenance facility workers, respectively, reported receiving "other" non-salary support. Respondents commonly identified other support as mobile phone airtime, snacks, T-shirts, and transport allowances. For "other" support, 94.1% of transition and 13.5% of maintenance workers who received it previously report decline or discontinuation ($p<0.001$).

Table 11: Changes in Support for HRH in Survey Facilities (Weighted)

Facilities			Statistical Tests	
	Transition	**Maintenance**	**Weighted χ^2 p-value**	**Unweighted Fisher's Exact Test**
Change in Frequency of Supervision for HIV	**N = 162**	**N = 12**		
Decrease	54.9%	9.2%	<0.001	0.002
Same	40.7%	70.1%		
Increase	4.4%	20.7%		
Change in Frequency of Supervision for MNCH	**N = 165**	**N = 15**		
Decrease	39.4%	13.7%	0.050	0.117
Same	51.9%	75.1%		
Increase	8.7%	11.2%		
Training Since Transition	**N = 206**	**N = 20**		
Any Topic (HIV, MNCH, etc.)	39.6%	61.7%	0.022	0.104
HIV-related	30.6%	44.4%	0.095	0.322
Mean HIV Training Days per Worker per Year Since Transition	1.70	4.34	Bootstrap p-value: 0.099	
Proportion of Workers with Salaries from PEPFAR IPs (Among Current Positions)	**Transition N = 200**	**Maintenance N = 20**	**D-in-D in Proportion (Gaussian C.I.)**	
Before Transition	6.0% (4.3 – 7.6%)	5.1% (1.9 – 8.3%)	-3.4% (-6.5, -0.3%)	
After Transition	0.5% (0.1 – 0.8%)	2.6% (0 – 5.4%)		
Mixed Effect Logistic Binomial Model (N = 452)	**Odds Ratio**		**p-value**	
D-in-D[1]	0.141 (0.015, 1.320)		0.086	
HIV Workers				
Proportion of workers Reporting Decline in/Loss off Non-Salary Support Among Those Receiving It	**Transition**	**Maintenance**	**Weighted χ^2 p-value**	**Unweighted Fisher's Exact Test**
Top-Ups or Bonuses	100% (N = 1)	98.8% (N = 53)	0.805	1.000
Outreach Allowances	95.3% (N = 187)	25.4% (N =15)	<0.001	<0.001
Other	94.1% (N = 103)	13.5% (N = 7)	<0.001	<0.001

[1]Full model results presented in Table 43.

Footnote: D-in-D: difference-in-difference; IP: implementing partner; HIV: human immunodeficiency virus; MNCH: maternal, neonatal and child health.

Table 12 presents the results of a bivariate analysis of health workers' responses to transition examining terminations, time-allocation, job satisfaction, and motivation. Transition facilities were more likely to report terminating any positions in their HIV workforce (25.7% vs. 0%, p=0.005). Transition facilities terminated, on average, 9.5% of their pre-transition HIV. The most frequently terminated cadres were volunteers (29% of terminated workers), lab technicians/assistants (13%), peer educators/mentor mothers (11%), community health workers/outreach workers (11%), and voluntary testing and counselling (VTC) counselors (10%). The category of "Volunteers" may include "expert patients", who are often paid small honoraria or transit allowances to assist in patient education, monitoring, and/or adherence counseling.

Among the workers surveyed, there were clear differences reported in changes to their time-allocation. Transition facility workers were less likely to report an increase in time-allocation for HIV clinical care compared to maintenance. Transition facilities were also significantly less likely to report an increase (or more likely to report a decrease) for time spent in training (p<0.001), meetings (p<0.001), reporting (p=0.023), and administration (p=0.028). The change in time-allocation for non-HIV clinical care was not significantly different between facility types (p=0.148). Job satisfaction and motivation index scores were also not significantly different for maintenance and transition workers.

Table 12: HRH Responses to Transition

Outcome: Termination of Health Workers	Transition (N = 206)	Maintenance (N = 20)	Weighted χ² p-value	Unweighted Fisher's Exact Test p-value
Any Terminations	25.7%	0%	0.005	0.005
Proportion HIV Workers Terminated	9.5%	0%	N/A	N/A
Changes in Time Allocation				
… for HIV Clinical Care	**Transition (N = 427)**	**Maintenance (N = 46)**	**Weighted χ² p-value**	**Unweighted Fisher's Exact Test**
Increase	33.6%	59.0%	0.002	0.003
Same	34.3%	29.8%		
Decrease	32.1%	11.2%		
… for Non-HIV Clinical	**Transition (N = 426)**	**Maintenance (N = 46)**	**Weighted χ² p-value**	**Unweighted Fisher's Exact Test**
Increase	43.3%	55.3%	0.148	0.078
Same	43.0%	41.1%		
Decrease	13.6%	3.6%		
… for Reports	**Transition (N = 426)**	**Maintenance (N = 46)**	**Weighted χ² p-value**	**Unweighted Fisher's Exact Test**
Increase	29.4%	49.2%	0.023	0.002
Same	52.2%	41.3%		
Decrease	18.5%	9.5%		
… for Meetings	**Transition (N = 428)**	**Maintenance (N = 46)**	**Weighted χ² p-value**	**Unweighted Fisher's Exact Test**
Increase	15.0%	33.2%	<0.001	<0.001
Same	45.8%	60.9%		
Decrease	39.2%	6.0%		
… for Training	**Transition (N = 426)**	**Maintenance (N = 45)**	**Weighted χ² p-value**	**Unweighted Fisher's Exact Test**
Increase	**6.1%**	**20.9%**	**<0.001**	**0.005**
Same	**13.1%**	**44.6%**		
Decrease	**80.8%**	**34.5%**		
… for Administration	**Transition (N = 406)**	**Maintenance (N = 43)**	**Weighted χ² p-value**	**Unweighted Fisher's Exact Test**
Increase	18.0%	32.3%	0.028	0.005
Same	65.9%	63.9%		
Decrease	16.1%	3.9%		
Motivation & Satisfaction				
Job Satisfaction	**Transition (N = 433)**	**Maintenance (N = 46)**	**Weighted χ² p-value**	**Unweighted Fisher's Exact Test**
Extremely Satisfied	4.4%	9.5%	0.223	0.168
Somewhat Satisfied	62.7%	64.3%		
Neither Satisfied nor Dissatisfied	13.6%	3.6%		
Somewhat Dissatisfied	17.7%	22.6%		
Extremely Dissatisfied	1.5%	0%		
Worker Motivation Index	**Transition (N = 433)**	**Maintenance (N = 46)**	**T-Test**	
Mean	3.92	3.97	0.399	

Footnote: HIV: human immunodeficiency virus.

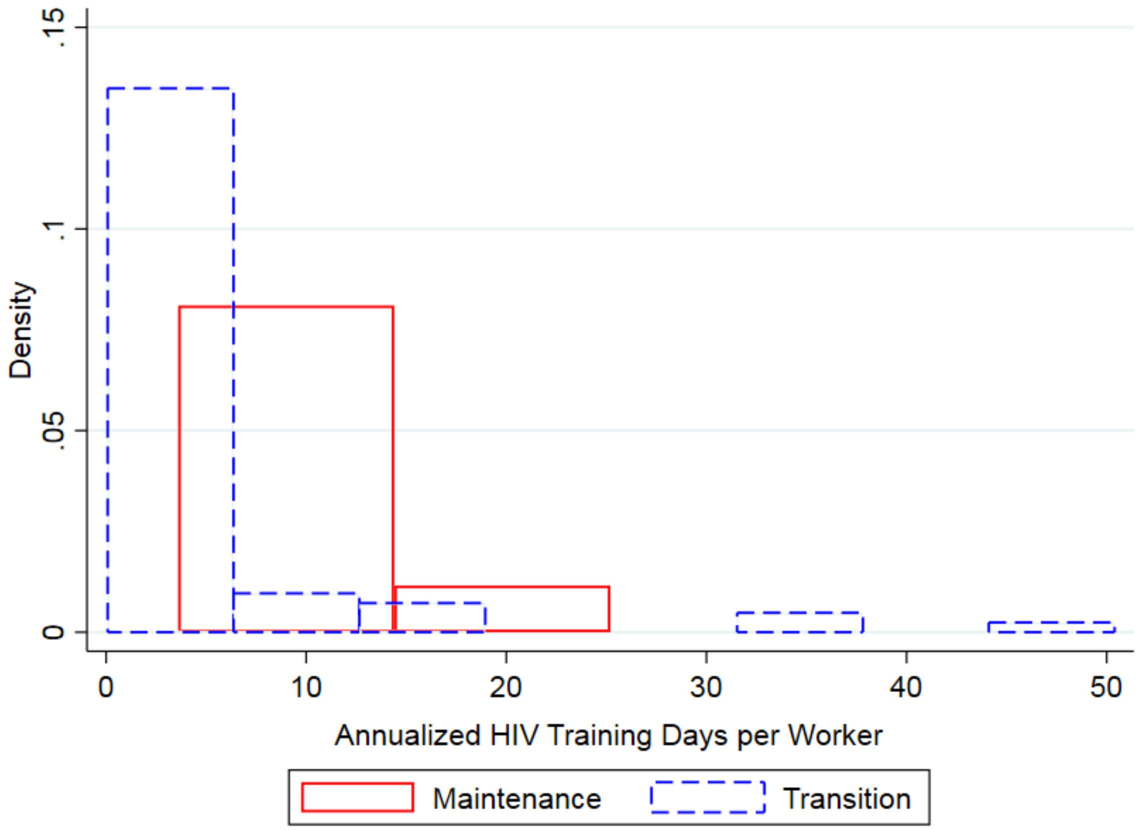
Bivariate analyses showed that transition workers reported less time on training but the difference in annualized HIV training-days per worker were not significant. In Table *13*, I present the results of a multivariate analysis of training. Using bootstrap resampling and adjusting for facility characteristics, the difference in annualized HIV training days per worker declines to 2.47 days and is not statistically significant (p=0.070). Workers in larger facilities had more HIV training-days, on average, and workers in the central support districts tend to have fewer training days. Examining the distribution of the data in Figure 5, the distribution is highly non-normal and influenced by outliers. The high outliers are likely due to facilities that report having many workers trained since a recent transition date, resulting in a large amount of estimated training days per year. Removing the outliers would favor maintenance facilities even more strongly. In the interest of being conservative, I have opted to keep the outliers in the data.

Table 13: Multivariate Regression of Annualized HIV Training Days per Worker

	Unadjusted Bootstrap S.E.	Adjusted Bootstrap S.E.
	Training Days (95% C.I.) ***p-value***	**Training Days (95% C.I.) p-value**
Transition vs. Maintenance	-2.644 (-5.789, 0.502) 0.099	-2.474 (-5.147, 0.199) 0.070
Level		
HC III vs. HC II		1.325 (-0.133, 2.784) 0.075
HC IV vs. HC II		**3.338*** **(0.111, 6.565)** **0.043**
Hospital vs. HC II		5.623 (-1.851, 13.10) 0.140
Ownership		
PNFP vs. Public		2.818 (-1.137, 6.774) 0.163
PFP vs. Public		-0.788 (-1.715, 0.138) 0.095
HIV Workforce Size		0.036 (-0.268, 0.340) 0.815
New District		0.358 (-0.682, 1.398) 0.500
CS District		**-1.376*** **(-2.594, -0.157)** **0.027**
Constant	**4.340**** **(1.295, 7.386)** **0.005**	2.738 (-0.469, 5.946) 0.094
N	219	219
R^2	0.017	0.124

Footnote: S.E.: standard errors.

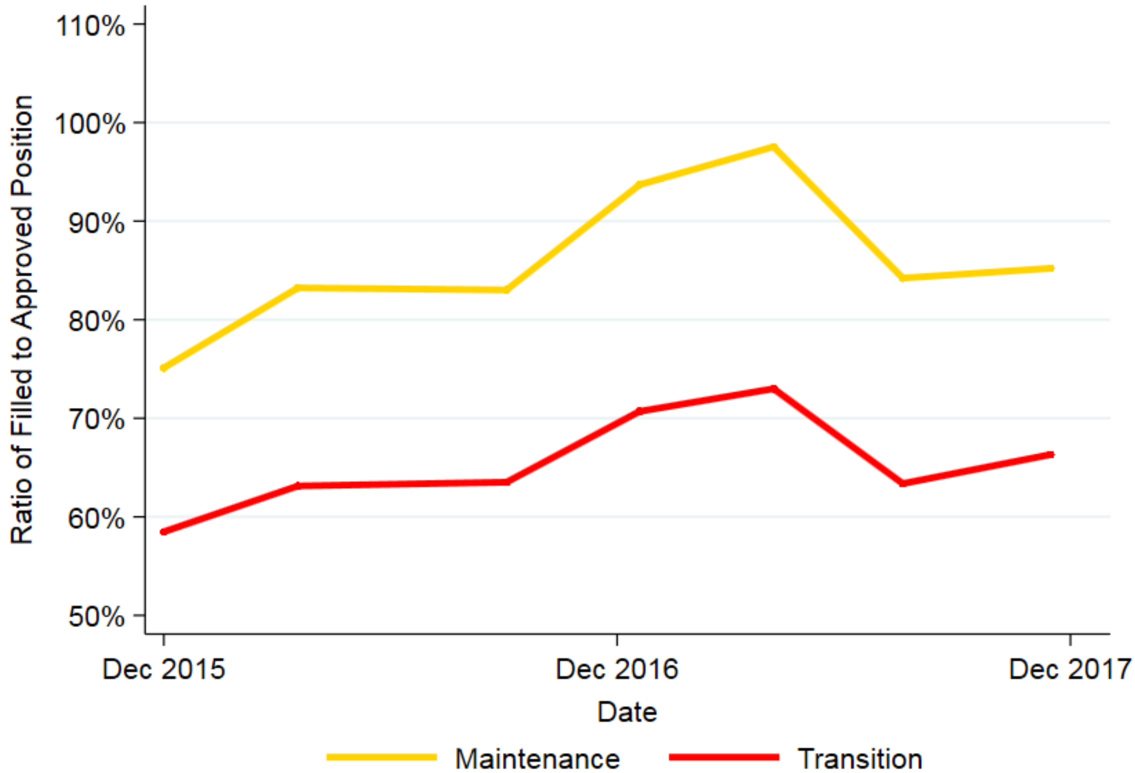
Figure 5: Histogram of HIV Training Days per Worker per Year by Transition Status



2.4.2 HRHIS Data: All Available Data from Public Health Facilities

Turning to the HRHIS outcomes, Figure 6 presents trends in "all cadre" staffing levels by transition status. The trends appear to be parallel, with transition facilities consistently having about 15 percentage points lower unadjusted staffing ratios.

Figure 6: All Cadre Staffing Trends by Transition Status (Full Sample)



Examining the D-in-D models (Table 14), the parallel trends are confirmed by statistical models. The unadjusted D-in-D in all cadre staffing is -1.3 percentage points (95% C.I.: -4.7, 2.2; p=0.480). The interpretation is not changed by controlling for confounding by level or region. For nurses and midwives, Figure 7 suggests that there some convergence in nurse and midwife staffing ratios for transition and maintenance facilities. The unadjusted D-in-D is 4.2p.p. (95% C.I.: -4.6, 12.9; p=0.349). Adjusting for confounding by level and region, the D-in-D becomes negative: -4.1p.p. (95% C.I.: -15.2, 7.1; p=0.474).

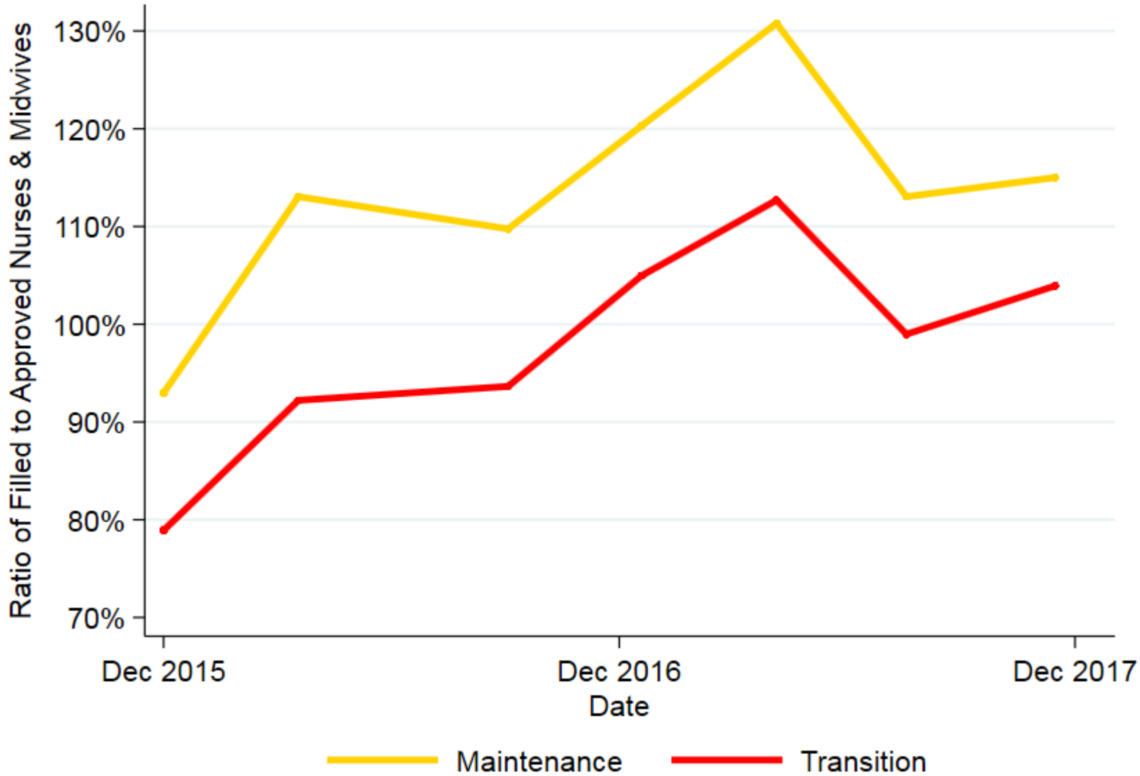
Controlling for level and ownership only, transition facilities have 11.3p.p. lower baseline “all cadre” staffing and 23.3p.p. lower “nurse & midwife” staffing ratios. For maintenance facilities, staffing increased by 10 percentage points for “all cadre” and roughly 22 percentage points for nurses and midwives between December 2015 and December 2017. Facility upgrades resulted in 24.9 percentage points lower “all cadre” staffing and 29.4 percentage points lower staffing ratios for nurses and midwives.

Table 14: Multivariate Models of Staffing Ratios

	All Cadre		Nurses & Midwives Only	
	Unadjusted	**Adjusted for Confounding**	**Unadjusted**	**Adjusted for Confounding**
	Ratio (95% C.I.) p-value	*Ratio (95% C.I.) p-value*	*Ratio (95% C.I.) p-value*	*Ratio (95% C.I.) p-value*
Transition Facility (vs. Maintenance Facility)	**-0.113** (-0.179, -0.047) 0.001**	**-0.111** (-0.174, -0.048) 0.001**	**-0.233*** (-0.342, -0.124) <0.001**	**-0.192*** (-0.291, -0.094) <0.001**
Post Transition Period (vs. pre-transition)	**0.100*** (0.074, 0.126) <0.001**	**0.102** (0.045, 0.16) 0.001**	**0.220*** (0.159, 0.281) <0.001**	**0.274** (0.106, 0.442) 0.001**
D-in-D: Transition x Post-Transition Period	-0.013 (-0.047, 0.022) 0.480	-0.016 (-0.059, 0.027) 0.468	0.042 (-0.046, 0.129) 0.349	-0.041 (-0.152, 0.071) 0.474
Facility Upgrade	**-0.249*** (-0.329, -0.17) <0.001**	**-0.249*** (-0.329, -0.17) <0.001**	**-0.294*** (-0.417, -0.171) <0.001**	**-0.294*** (-0.417, -0.171) <0.001**
Level				
HC III vs. HC II	**0.132** (0.057, 0.208) 0.001**	**0.143*** (0.072, 0.213) <0.001**	**-0.163* (-0.296, -0.031) 0.016**	-0.066 (-0.176, 0.045) 0.245
HC IV vs. HC II	0.086 (-0.014, 0.186) 0.092	0.092 (-0.003, 0.186) 0.057	-0.064 (-0.245, 0.117) 0.486	0.045 (-0.109, 0.199) 0.569
Hospital vs. HC II	-0.049 (-0.156, 0.059) 0.374	-0.056 (-0.159, 0.047) 0.287	**-0.611*** (-0.783, -0.439) <0.001**	**-0.500*** (-0.648, -0.353) <0.001**
Region				
Eastern vs. Central	0.015 (-0.059, 0.09) 0.689	0.003 (-0.072, 0.077) 0.942	-0.118 (-0.246, 0.011) 0.073	**-0.196** (-0.332, -0.059) 0.005**
Northern vs. Central	0.026 (-0.039, 0.091) 0.427	0.031 (-0.035, 0.097) 0.360	**-0.175** (-0.293, -0.057) 0.004**	**-0.211** (-0.342, -0.08) 0.002**
Western vs. Central	0.088 (-0.013, 0.19) 0.088	0.064 (-0.035, 0.163) 0.205	-0.007 (-0.193, 0.179) 0.941	-0.108 (-0.275, 0.059) 0.203
Level x Post				
HC III vs. HC II		-0.021 (-0.07, 0.028) 0.405		**-0.193** (-0.322, -0.065) 0.003**
HC IV vs. HC II		-0.011 (-0.084, 0.062) 0.762		**-0.216* (-0.409, -0.024) 0.027**
Hospital vs. HC II		0.015 (-0.056, 0.085) 0.685		**-0.220** (-0.376, -0.063) 0.006**
Region x Post				
Eastern vs. Central		0.025 (-0.033, 0.082) 0.399		0.154 (-0.003, 0.311) 0.054
Northern vs. Central		-0.009 (-0.063, 0.045) 0.747		0.071 (-0.08, 0.221) 0.358
Western vs. Central		0.048 (-0.019, 0.115) 0.161		**0.201* (0.008, 0.394) 0.041**
Constant	**0.629*** (0.544, 0.713) <0.001**	**0.627*** (0.544, 0.711) <0.001**	**1.193*** (1.049, 1.337) <0.001**	**1.166*** (1.016, 1.316) <0.001**
N facilities	667	667	667	667
	1,310	1,310	1,310	1,310

Footnotes: HC: health centre.
*p<0.05, **p<0.01, ***p<0.001

Figure 7: Nurses and Midwife Staffing (Full Sample)



2.4.3 HRHIS Data: Survey Facility Sample

Restricting the data to the facility survey sample, there are 166 public facilities with prior PEPFAR support. Of these, 144 facilities (86.7%) have data for either December 2015 or December 2017, including 12 facilities reporting maintenance and 134 facilities reporting transition. Out of the 166 eligible facilities, 136 (81.9%) have complete data (i.e. both Dec 2015 & Dec 2017).

Figure *8* shows that there is a small divergence in "all cadre" staffing in these facilities taking place at the end of 2017. The diverging trend is also noted for nurses and midwives (

Figure *9*). The unadjusted D-in-D in staffing is -6.9p.p. (-21.4, 7.7; p=0.355) for all-cadre and -25.3 percentage points (-52.4, 1.8; p=0.067) for nurses and midwives. Adjusting for interactions with level, the D-in-D does not change substantially.

Figure 8: All Cadre Staffing Ratios in Survey Facilities (Survey Sample)

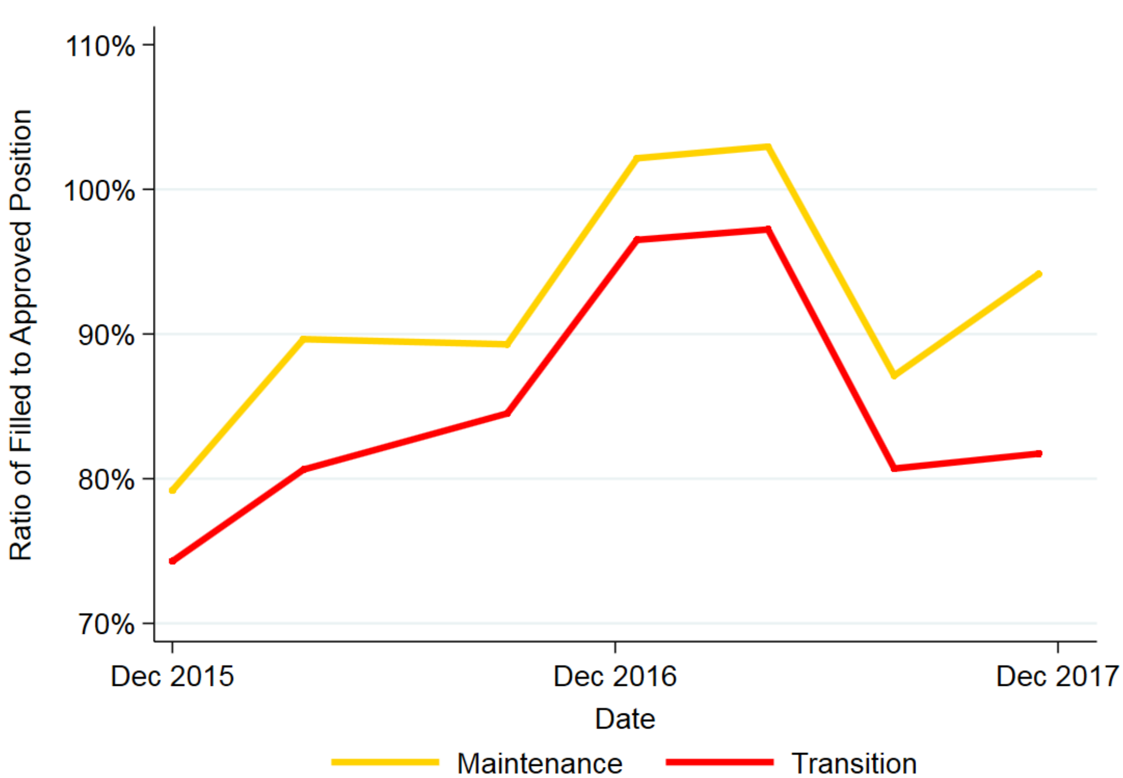
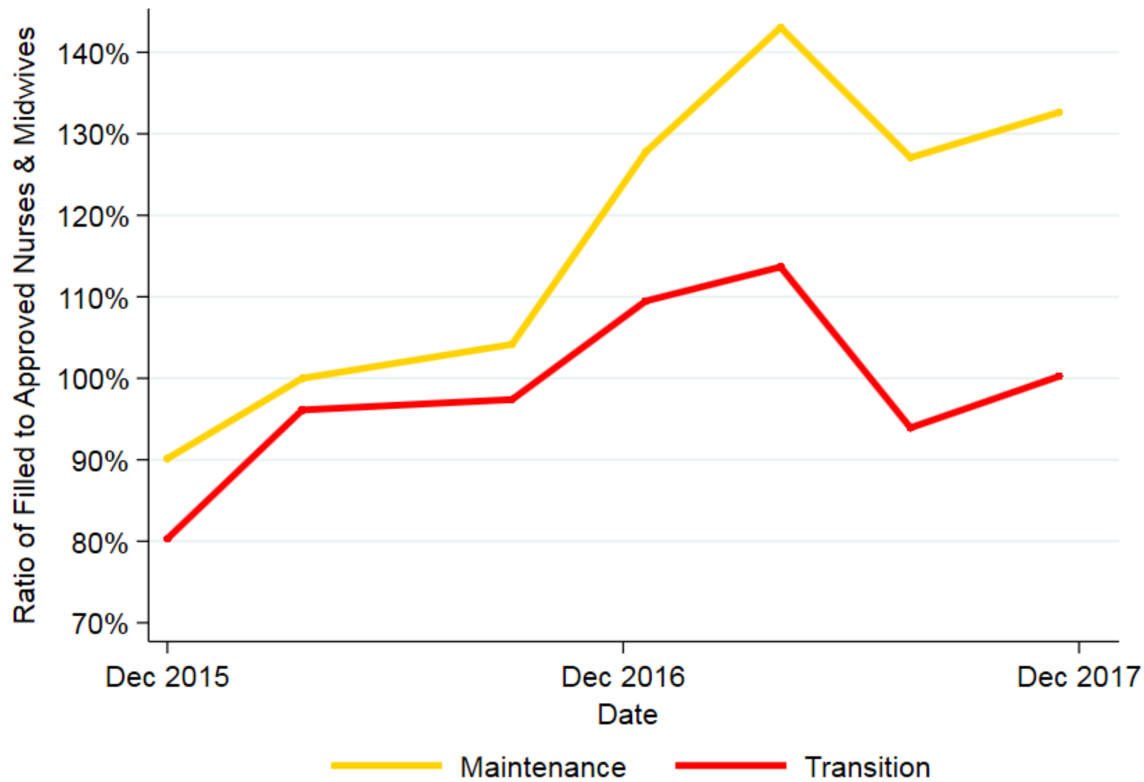


Figure 9: Nurse and Midwife Staffing Ratios in Survey Facilities (Survey Sample)



Within the facility survey sample, baseline differences in “all cadre” and “nurse & midwife” staffing ratios are smaller than for all HRHIS data as a whole, and the increase in maintenance (i.e. “Post Transition”) is larger, particularly for nurses and midwives.

Table 15: Multivariate Regression of Staffing Ratios (Facility Survey Sample)

	All Cadre		Nurses & Midwives	
	Unadjusted	**Adjusted for Level**	**Unadjusted**	**Adjusted for Level**
	Ratio (95% C.I.) p-value	***Ratio (95% C.I.) p-value***	***Ratio (95% C.I.) p-value***	***Ratio (95% C.I.) p-value***
Transition vs. Maintenance	-0.079 (-0.199, 0.042) 0.200	-0.071 (-0.189, 0.048) 0.242	-0.109 (-0.403, 0.185) 0.467	-0.107 (-0.401, 0.188) 0.478
Post Transition	0.141 (0, 0.282) 0.050	0.093 (-0.12, 0.307) 0.390	**0.458** (0.196, 0.72) 0.001**	**0.436** (0.111, 0.762) 0.009**
Difference-in-Difference	-0.069 (-0.214, 0.077) 0.355	-0.084 (-0.237, 0.069) 0.283	-0.253 (-0.524, 0.018) 0.067	-0.257 (-0.542, 0.028) 0.077
Facility Upgrade	**-0.185 (-0.287, -0.083) <0.001**	**-0.185 (-0.287, -0.083) <0.001**	-0.185 (-0.389, 0.019) 0.075	-0.185 (-0.389, 0.019) 0.076
Level				
HC III vs. HC II	0.030 (-0.128, 0.188) 0.711	0.000 (-0.16, 0.16) 0.997	**-0.332* (-0.638, -0.025) 0.034**	**-0.347* (-0.613, -0.081) 0.011**
HC IV vs. HC II	0.089 (-0.093, 0.27) 0.338	0.040 (-0.136, 0.216) 0.655	-0.101 (-0.478, 0.276) 0.599	-0.114 (-0.423, 0.195) 0.470
Hospital vs. HC II	-0.144 (-0.334, 0.045) 0.136	**-0.220* (-0.408, -0.031) 0.022**	**-0.702*** (-1.021, -0.383) <0.001**	**-0.705*** (-0.99, -0.421) <0.001**
Region				
Northern vs. Eastern/Central	-0.041 (-0.121, 0.039) 0.314	-0.041 (-0.121, 0.039) 0.314	**-0.147* (-0.272, -0.022) 0.021**	**-0.147* (-0.272, -0.022) 0.021**
Level x Post				
HC III vs. HC II		0.061 (-0.119, 0.24) 0.510		0.030 (-0.266, 0.326) 0.843
HC IV vs. HC II		0.098 (-0.085, 0.28) 0.293		0.025 (-0.324, 0.375) 0.887
Hospital vs. HC II		0.152 (-0.035, 0.338) 0.111		0.007 (-0.303, 0.317) 0.964
Constant	**0.806*** (0.596, 1.016) <0.001**	**0.870*** (0.611, 1.13) <0.001**	**1.248*** (0.769, 1.728) <0.001**	**1.259*** (0.808, 1.71) <0.001**
N facilities	144	144	144	144
N obs.	282	282	282	282

Footnote: HC: health centre.
*p<0.05, **p<0.01, ***p<0.001

2.5 Discussion

Transition facilities in our facility survey sample differed slightly in their ownership status and levels but were similar to maintenance facilities in their PEPFAR support at baseline. However, during transition the frequency of HIV supervision and the level of non-salary support declined more in transition. Declines in salary support from IPs and declines in MNCH supervision were greater in transition facilities, but not significantly so. There is not enough evidence from the cross-sectional measure of training to be sure that observed differences are significant, much less evidence that these differences are related to transition. Yet, 77% of transition facility in-charges report declining access to trainings and declining worker time-allocation for training was reported by 80.8% of transition workers compared to 34.5% of maintenance. Therefore, at least some evidence suggests that training was affected.

Transition was also associated with a number of health worker outcomes, including termination of HIV workers, reduced time allocation for HIV clinical care, reporting, training, and administration. Transition facilities terminated 9.5% of their HIV workforces (mostly lay health workers). However, job satisfaction and motivation were not different among remaining workers.

Despite terminations, there is no evidence of declines in staffing ratios for formal cadres at transitioned public health facilities. Nurse & midwife staffing actually increased more in transitioned facilities than maintenance, using USAID's classification in the ITT analysis. Using the facility survey sample, transition facilities had a negative D-in-D, but the results were not statistically significant. These findings are not surprising, as the most commonly terminated positions were lay health worker cadres, not MOH-approved cadres.

There are several limitations in this analysis. First, our uncertainty in the transition status for many facilities is a major limitation. Even using the self-reported transition status, we cannot be sure if the respondent is mistaking a gap in support for transition. If there was a gap in support, the impacts of transition noted may not last when support returns. Connected to this issue, we have a small sample size of maintenance facilities (N=20) in our facility survey, which makes the results for staffing ratios and training uncertain and potentially sensitive to outliers.

Secondly, most questions related to HRH in the facility survey were retrospective and, therefore, rely on recall and self-report. Our findings could be biased by differential recall, such as in-charges being more likely to recall terminating a post if transition occurred than if it did not. It is also possible that in-charges in transition facilities deliberately sought to paint transition in a negative light in order to influence policymakers to restore support. Furthermore, for cross-sectional measures, such as training, job satisfaction, and motivation, the analysis is limited by the potential for residual confounding by unobserved factors.

Lastly, the HRHIS is a relatively new and somewhat untested data source. HRHIS data is supposed to be updated when staffing changes; however, I do not have clear information on how rapidly or completely the data is updated when changes in staffing occur. The restriction to public facilities and the 80% reporting rate limit the generalizability of evidence from HRHIS data. The exclusion of lay health workers is also a limitation, given that these cadre were most affected by terminations in our facility survey. Readers should be cautious in drawing causal interpretations from the HRHIS due to the plausibility of confounding (or regionally varying effects of transition), uncertainty in the measurement of transition, and violations of the assumption of independence between facilities.

The findings present a mixed picture for how transition might affect human resources for health at the facility level. The loss of inputs, such as supervision and training, could place the quality of care for HIV services at risk. Job satisfaction, motivation, and staffing levels suggest that transition had limited impact on morale and staffing. However, transition facilities also have fewer lay health workers than before transition as a result of terminations. Given the importance of lay health worker cadres for HIV testing and patient adherence, there may be long-term impacts for the populations these facilities serve. In the second paper in this dissertation, I examine utilization of key HIV and non-HIV services in more depth.

This study adds to the very limited literature on the impact of transitioning GHIs on HRH. The findings also shed light on the impacts that PEPFAR may have had when it was in place. PEPFAR provided additional inputs to health workers in the form of incentives, supervision, and access to training. At the time of our survey, such inputs that had not been replaced by government or other sources and, to the best of our knowledge there were no future plans to do so. However, the loss of these incentives have not had an immediate impact on staffing rates or motivation and satisfaction, which suggests that there distortional effect was limited. Yet, transition workers' reports of reduced time-allocation for meetings, training, HIV care, and reporting (relative to maintenance) support the view that PEPFAR support resulted in increased time spent in these activities. But there is no shift to non-HIV care in transition that would suggest that PEPFAR's time burdens came at the expense of non-HIV care. This null finding would agree with a recent study in Uganda that found ART scale-up to be unassociated with trends in outpatient department visits, suggesting that large increases in HIV care have not crowded out this general measure of non-HIV service delivery (68).

The decline in HIV supervision is not surprising, given that PEPFAR IPs are required to provide quarterly site visits to supported facilities. Since trainings continue to occur, declining access to trainings in transition facilities could be explained by workers no longer receiving transport and other allowances to enable them to attend. Donors and governments should explore less costly training models that are resilient to loss of donor financing. Cascading or training the trainers (TTT) models, where workers are prepared off-site in order to train their peers on-site, can reduce reliance on donors to support travel costs. This model has been evaluated for ophthalmology trainings across Sub-Saharan Africa (104). However, small facilities may be ignored in this model, as they lack a critical mass of potential trainees, and support for transition facility trainers to attend may even be lacking.

The termination of lay health workers during transition in Uganda was predictable. Health facilities, particularly public facilities, lack the financial resources and budgetary flexibility to support salaries for these workers after transition. The national community health worker program in Uganda, the Village Health Teams, consists of unpaid volunteers, who have restricted mobility as a result of lacking transportation allowances and basic supplies, resulting in high dropout intentions (105). The Village Health Team programs studied in Mukono and Wakiso are themselves dependent on funding from donor programs (105).

Village Health Teams may not be able to absorb lay health workers, but they also cannot replace them. Given that donor-supported HIV lay health workers have training, experience, and established linkages with facilities and patients, maintaining them is preferable to replacing them with other personnel. There is some evidence that HIV patients are willing to use Village Health Teams as a provider, but there is a preference for those who are also HIV+, indicating the importance of peer support and sensitization of community providers (106). Therefore, replacing

HIV-specialized lay health workers supported by IPs (including HIV+ “expert patients” and peer educators) with generic community health volunteers will be less effective than retaining them.

However, merely retaining the workers is insufficient if DHOs and facilities are not equipped to supervise them. Transitioning responsibilities for supervision requires planning. Transition coordination between MoH, PEPFAR, and districts did not occur as planned. Interviews conducted through the parent study revealed that a transition team was assembled by the MoH, but ultimately did not meet (L. Paina, personal communication, September 27, 2016). Had transition planning taken place, ad hoc mechanisms could have been developed to provide bridge support and supervision for lay health workers until something more permanent could be created.

These cadres are important to the HIV response, reaching patients outside of facilities for testing and linkage to care (107, 108). They can also reduce burdens on health facilities through community distribution of ART (109), which is particularly useful as the “Test and Treat” policy increases the number of patients on ART. There is considerable evidence that including CHWs or peer mentors in facility-based PMTCT and ART programs increases their effectiveness (110, 111). Moreover, the cost of maintaining lay health workers is generally low, and lay and community health worker models have been shown to be cost effective in a number of settings (112). However, there are numerous barriers to absorbing these cadres into national systems in LMICs, including wage bill caps and the weak position of health ministries in the budgeting process, which have resulted in few countries studied finding a way to absorb lay cadres effectively (108). Given the challenges, advanced planning and bridge support are even more important.

Not all of the possible impacts of GHIs on HRH can be revealed through the withdrawal of support. Genuine health system strengthening may have made facilities less responsive to loss of assistance. There may also be some gap-filling through DHOs or coping mechanisms at the facility level. Despite these limitations, the withdrawal of support remains informative about PEPFAR's effects on HRH in Uganda.

Transition of PEPFAR support was associated with negative impacts on HRH at transitioned health facilities. HRH needs to be considered during transitions of all donor health programs. Furthermore, transition planning is needed to mitigate the impact of transition on HRH at the facility level. Planning should attempt to institutionalize donor-supported functions into existing or new national programs, particularly support for lay health workers. However, donors should also be prepared to provide bridge support until national programs are prepared to take on the functions transitioned by GHIs. This study was limited in follow-up time. Future research should examine some of the longer-term impacts on health worker training and skills following transition.

Chapter 3. "The Impact PEPFAR Geographic Prioritization on HIV & non-HIV service delivery in Uganda"

3.1 Abstract

Uganda has relied heavily on support from donors, including the President's Emergency Plan for AIDS Relief (PEPFAR), to provide HIV services. In 2015, PEPFAR identified 734 facilities for transition from site-level support in Uganda by end of 2016. I seek to measure the impact of PEPFAR's transition on service availability, volume, and self-reported quality.

Using data from a facility survey conducted in mid-2017, I collect information reported by facility in-charges on the availability, access, and quality of key HIV and non-HIV services. I compare responses for facilities transitioned from PEPFAR to those maintained on constant PEPFAR support using weighted Chi-square and the unweighted Fisher's exact tests. I also use counts of services provided from the district health information system (DHIS2) for the period Oct 2013–December 2017 to assess trends in utilization of HIV (testing & counseling, antiretroviral treatment, and retention on treatment) and non-HIV (outpatient visits, antenatal care, facility deliveries, and DPT3 immunization) services. I use mixed effect models to analyze the difference in trends and levels of indicators comparing transition to maintenance facilities.

Out of 226 PEPFAR-supported facilities surveyed, 206 reported transition and 20 reported maintenance. Transition facility in-charges were more likely to report discontinuation of HIV outreach (51.6% vs. 4.1%, $p<0.001$) and worsening patient access to HIV (43.5% vs. 3.1%, $p<0.001$) and MNCH care (23.9% vs. 0%. $p<0.001$). Transition facilities also perceived worsening quality of HIV and MNCH care. However, the volume of HIV and MNCH services is either not lower in transition facilities compared to maintenance, is actually higher, or the differences do not appear to be related to transition.

Despite negative effects on service delivery reported by facilities, there is a lack of evidence that PEPFAR transition has affected either HIV or MNCH care in the first year. Additional research is needed to assess the long-term impacts of site-level transition on service delivery. The discontinuation of outreach has the potential to impact HIV services and hinder Uganda's progress towards the 90-90-90 goal.

3.2 Introduction

In order to target resources to regions with high unmet HIV needs and the facilities capable of meeting these needs, the President's Emergency Plan for AIDS Relief (PEPFAR) launched the Geographic Prioritization (GP) in the 2016 fiscal year across all 15 PEPFAR "long-term strategy" countries (4). "Long-term strategy" is a category that, under PEPFAR FY2014 Guidance, is characterized by high need for external support, high HIV prevalence, and limited domestic financial resources (14). The GP included both regional and low-volume facility components. In Uganda, GP resulted in 10 districts in Northeastern Uganda and their 94 facilities being identified for transition to "central support" as well as another 640 more facilities being identified as "low-volume" across Uganda by PEPFAR accounting (17). Transition was to take place between October 2015 and September 2016, which was extended to March 2017 (22).

Transition facilities were to lose any site-level support that they received from PEPFAR implementing partners (IPs), which commonly includes supervision, training, incentives and salaries for health workers, and support for outreach. Above-site support systems, including laboratory networks and commodity supply chains, remain in place (17). However, facilities may have new difficulties in accessing these systems without IP support for ordering and transport. In Uganda, many of these forms of support are also provided — at least to public facilities — by districts and national government; and transition implies that government would take over these roles. However, there is no specific mechanism to ensure government takes over the functions performed by PEPFAR IPs. The loss of support for health facilities in Uganda raises important questions about the sustainability of PEPFAR's investments in service delivery.

PEPFAR's positive impact on HIV service delivery in Sub-Saharan Africa and Uganda, in particular, is well widely acknowledged (2, 56). Several studies have addressed the impact of HIV programs on non-HIV services as well (56-68). However, relatively few studies have evaluated the effect of transitioning HIV programs on HIV services (28, 30, 33, 69-75). Furthermore, I am aware of no previously published studies that have examined the effects of transition on non-HIV services empirically. In Rwanda, HIV services increased while PEPFAR support was scaled-back and funding transitioned to a budget-support model (70) and Farmer et al. (2013) report continued improvements in maternal, neonatal, and child health (MNCH) outcomes coincident with Rwanda's HIV program transition, but does not explore the association (72).

There are reasons to expect that non-HIV services will be affected by transition. Many PEPFAR IPs provide direct support to both MNCH as well as HIV/AIDS services and may use resources for HIV to support both types of care. Indirectly, increasing prevention of maternal-to-child transmission (PMTCT) and early infant diagnosis (EID) requires high utilization of antenatal care (ANC) and post-natal care (PNC) by women and newborns. Facility upgrades and service quality improvements benefit HIV as well as non-HIV services. Training and supervision of health workers may also have spillover benefits for non-HIV care. Alternatively, PEPFAR supervision and incentives may crowd-out MNCH care by encouraging staff to engage in more

HIV care. Therefore, the net effect of PEPFAR support on non-HIV services is ambiguous, as is the effect of transition of support.

3.2.1 Objectives

This study aims to measure the impacts of the withdrawal of site-level support on HIV and non-HIV service delivery at the facility level in Uganda. This paper has three specific objectives. First, I examine whether or not transition facilities are more likely to discontinue provision of any HIV or non-HIV service compared to facilities maintained on a constant level of PEPFAR support. Secondly, I want to understand how transition affects patient access to and quality of HIV and MNCH services, as reported by facility in-charges. Thirdly, using secondary longitudinal data from DHIS2, I compare trends in select services for transitioned and maintained facilities to identify if volume of HIV and non-HIV services was affected by transition. Two key hypotheses drive the study design of this paper. First, I assume that PEPFAR has been supporting HIV service delivery, including the provision of key HIV services, and I expect that transition from PEPFAR will result in reduced patient access and service quality, discontinuation of HIV services, and/or reduced volume of HIV services. Secondly, I also expect that transition will have negative impacts on the availability, quality, and volume of non-HIV services.

3.3 Methods

This paper uses quantitative data obtained from two separate sources: a facility survey and secondary, routine data on delivery of health services from the District Health Information System 2.0 (DHIS2). The survey data contributes to objectives 1 & 2. DHIS2 data contributes to the 3rd objective (Table 16).

3.3.1 Facility Survey Data: Objectives 1 & 2

A facility survey was conducted by a joint Johns Hopkins/Makerere University study team in July & August of 2017. We expected transition to take place in mid-2016; however, the process was not completed until March of 2017, according to USAID. The survey was conducted roughly nine months after the transition midpoint (October 2016) and five months after the official end of the GP.

The survey sample frame was drawn from a list of health facilities identified by the United States Agency for International Development (USAID) as PEPFAR-supported in FY2014. The list designated each facility as either maintenance, scale-up, or transition. For logistical reasons, the study team limited the sampling area for this survey to 40 districts in Northern and Eastern Uganda, as well as Kampala and Wakiso districts. This area contained 9 of the 10 districts that were identified for all facilities to be transitioned, known as "central support districts" as well as the majority of facilities designated for maintenance. Kampala and Wakiso are urban districts that contain a substantial fraction of the private for-profit (PFP) sites designated for transition from PEPFAR support. We sampled transition facilities within priority districts, but we did not sample any facilities identified for scale-up. We also restricted the sample frame to facilities that were supported by IPs contracted to USAID, per the requirements of the funder for the parent study.

Table 16: Study Objectives, Data Sources, Outcomes, and Methods

Objectives	Data Sources	Transition Status	Outcomes	Analysis Methods
1.) Impact of transition on HIV and non-HIV service availability	Facility Survey	Self-report by facilities	• Discontinuation of HIV services • Discontinuation of MNCH services	Chi-square Test & Fisher's Exact Test
2.) Impact of transition on patient access and service quality	Facility Survey	Self-report by facilities	• Perceived Changes in Patient Access • Perceived Changes in Service Quality	Chi-square Test & Fisher's Exact Test
3.) Effect of transition on the volume of HIV and non-HIV services delivered	DHIS2	**Primary:** USAID transition designation **Secondary:** Self-report by facilities	• HTC • New on ART • Current on ART • OPD Visits • Total ANC visits • Facility Deliveries • DPT3/Penta-3 Immunization	Random intercept negative binomial regression models
			• Cohort Retention on First-line ART at 12 months • ANC4+ Coverage • IPT2 Coverage in ANC	Random intercept Gaussian regression

ART – antiretroviral therapy; ANC – antenatal care; DHIS2 – district health information system 2.0; ANC4+ coverage – ratio of 4th or higher order ANC visits to first ANC visits; DPT3/Penta-3 – diphtheria pertussis tetanus/ pentavalent immunization 3rd dose; HIV – Human Immunodeficiency Virus; HTC – HIV testing and counseling; IPT2 – intermittent prophylaxis therapy 2nd dose; MNCH – maternal, neonatal, and child health; OPD – outpatient department; USAID – United States Agency for International Development

We selected district primary sampling units from the sampling frame using a stratified random sampling design with three strata: (1) 100% selection of all districts containing transitioning HC IVs and/or Hospitals as well as Kampala & Wakiso districts, (2) random sampling of 11 out of 18 districts that were designated as central support or maintenance but did not contain transitioning HC IV/Hospitals, (3) random sampling of 6 out of 14 scale-up districts. Within selected districts, all facilities identified as PEPFAR-supported at baseline and scheduled for either transition or maintenance were included, except for Kampala and Wakiso, where we took a 40% random sample of transition facilities only. Using this process, a total of 275 facilities were included in the sample. We estimated 10% non-response and aimed for a final sample of 250. The sample size calculation is described in the Annex. Two case study facilities in the qualitative component of the parent study were purposively added to the sample for a total of 277.

Of the 277 facilities in the sample, enumerators were able complete surveys at 262 facilities. Of the 15 facilities that could not be surveyed, nine had closed permanently, two were closed for construction, two facilities were identified as duplicate records, one refused to participate in the survey, and one was not accessible on account of hazardous road conditions. Of the 262 facilities surveyed, 36 claimed to have had no PEPFAR support within the past 3 years, 206 reported having been transitioned, and 20 reported continuing to receive PEPFAR support. This was contrary to what was expected, due both to the 36 sites with no recent PEPFAR support and the larger than expected proportion of sites reporting transition (and smaller than expected proportion reporting maintenance). From follow-up interviews with IPs and USAID, we determined that as many as 60 of the transitioned facilities were experiencing a break in support between IPs lasting for about 9–12 months. As these facilities reported similar processes and impacts as those that were genuinely transitioned, we have included them as transition facilities in this analysis.

The survey asked each facility whether they provided any of four HIV services (ART, Outreach, PMTCT, and HTC) as well as five non-HIV services (ANC, deliveries, immunizations, nutrition, and child health clinic) related to MNCH. If the facility reported that they currently do not offer the service, the enumerator asked if they offered the service prior to the transition date. The transition date is reported by the facility in-charge if facility reports transition. If the facility does not report transition, a fixed reference date (October 1, 2016) is used. In-charge respondents were also asked general questions about trends in access and quality of HIV and MNCH services. Using this information, I compared responses on discontinuation and changes in quality or access across facilities reporting transition and maintenance using weighted Chi-square test. Analysis of the facility survey accounts of survey design using sampling weights, clustering at the district level, stratification, and finite population correction. However, many tables are sparse, with fewer than 5 cases in each cell, making the Chi-square test unreliable. Therefore, I also used an unweighted Fisher's exact test as a check. All analysis were performed using Stata 15 (99).

3.3.2 DHIS2 Data & Analysis: Objective 3

The second data source is a nationwide longitudinal record of aggregated counts of services provided by health facilities obtained from DHIS2. I used data from two health management information system (HMIS) reporting forms: HMIS 105, which is reported monthly and required for all health facilities, and HMIS 106a, which is reported quarterly and only submitted by facilities that provide HIV, TB, or other long-term services. The data covers the period October 2013 to December 2017. I selected HIV indicators that reflect each of the 90-90-90 goals — testing, treatment, and suppression — (5) as well as a variety of common MNCH indicators. Table 17 presents information on the indicators used in this analysis with some rationale for their inclusion. More explanation of the selection of indicators is included in the Annex.

Table 17: DHIS2 Indicators used in Uganda

Indicator & Shorthand	Comment	Derived Indicators	Rationale
Current on ART	Quarterly		Vital measure of ability to maintain or expand HIV services. ART is the second "90" in the "90-90-90"
ART Cohort 12 months	Number enrolling on ART four quarters prior.		Retention on ART, preferably first-line, is necessary for sustained virologic response, the third "90".
Net Cohort on First-line ART at 12 months	Quarterly; in 2015, Uganda switched from reporting both numerator and denominator for cohort to reporting the quotient only	Percent of Cohort Retained in care on First-line ART = Cohort_Num / Cohort_Denom	
New on ART	Quarterly		Additional to current on ART, new on ART measures flow rather than stock. Since new ART patients take more time than established patients, New on ART indicates ability to expand ART services.
HIV Testing & Counseling (HTC)			Since 19% of PLHIV are unaware of their status in Uganda, HTC is critical for the first "90"
HIV Testing Positive (HTC_Pos)		HTC_Yield = HTC_Pos / HTC	I include HIV yield to explain HTC trends: Is testing declining because of better targeting? It is not used elsewhere.
Outpatient Visits (OPD)			A generic measure of health facility service capacity. Driven by demand fluctuations (e.g. malaria incidence).
Total ANC Visits			Measure of attractiveness to pregnant women as a site of ANC
First ANC Visit (ANC1)			Used as a proxy for number of pregnancies.
Fourth or more ANC Visits (ANC4+)	4+ Visits	Coverage of ANC4+ = ANC4+ / ANC1	Completion of 4+ ANC visits is a proxy for quality of ANC: early initiation and repeated follow-up
Intermittent Prophylaxis Treatment in pregnancy, 2nd dose (IPT2)		Coverage of IPTp2 in ANC = IPT2 / ANC1	Metric of quality of ANC. Affected by stock-outs of Fansidar, neglect, and ANC timing and follow-up.
Facility Deliveries			Indicator of attractiveness as a place of delivery
DPT3/Penta3 Immunizations (DPT3)	Uganda's immunization guidelines switched from DPT/penta to Pentavalent only in 2015		Indicator or childhood care, 3 doses requires three visits before 12 months of age.

Footnote: ART: antiretroviral therapy; ANC: antenatal care; DPT3/Penta-3 – diphtheria-pertussis-tetanus/ pentavalent immunization 3rd dose; HIV: Human Immunodeficiency Virus; HTC: HIV testing and counseling; IPT2: intermittent prophylaxis therapy 2nd dose; MNCH: maternal, neonatal, and child health; OPD: outpatient department; PLHIV: people living with HIV.

This study relies heavily on HMIS data reported to the DHIS2. The HMIS is a set of administrative data collection systems intended for policymaking; however, since 2015 it has been used by PEPFAR for monitoring and evaluation of HIV service delivery. There has been limited use of HMIS/DHIS2 data in the peer-reviewed literature. In Uganda, Luboga et al. (2016) used district-level HMIS records (67). Other studies conducted in SSA have tended to use facility registries or reporting forms (61, 62, 66, 68) rather than centralized HMIS data. In this study, the information on service volume comes exclusively from the centralized DHIS2 dataset.

Following extraction from DHIS2, I merged each facility's data to lists of PEPFAR-supported facilities as of FY 2014 supplied by USAID mission in 2015 using integrated PEPFAR Site List identifiers (iPSL_ID) fields. The Uganda DHIS2 has no unique facility identifier, but I was able to match facility records to iPSL IDs using a linking key compiled by the Uganda M&E contractor project (B. Amuron, personal communication, September 27, 2016). I performed manual checking and manual matching to address any issues in matching. Using USAID's classification of sites, a total of 1,153 maintenance and transition facilities were included, of which 734 were transition and 419 were maintenance. An additional 1,385 sites were identified as scale-up, and I omit them from the analysis.

The transition intention in the USAID list agrees poorly with self-report by facilities. Given the discrepancies between sources on transition status, I conduct two analyses of the DHIS2 data. The primary analysis used all available data with the USAID-reported designation. However, in a secondary analysis, I used only the DHIS2 data for facilities in the facility survey sample and used the self-reported transition status.

I defined facilities that reported to DHIS2 at least two times during the predicted baseline period (October 2013 to June 2016) and at least two times during the predicted post-transition period (July 2016 to December 2017) as having enough data for analysis. At the outset of the project, July 2016 was our best guess for when transition would be completed. As most facilities are either non-reporters or fairly good reporters, more stringent criteria (e.g. requiring 3 reports from both periods) would not change the number of facilities included in the analysis considerably. There are a total of 1,006 maintenance or transition facilities with enough data for analysis of HMIS 105 outcomes out of a total of 1,153 such facilities (87.3%) (Table 18).

I performed a minimalist data cleaning with the goal of removing highly out-of-range data values that could bias the analysis. I could not remove all erroneous values caused by over or under-reporting. Therefore, I opted to remove the most extreme high values. I took the average of each data field by facility and identified large outlier values relative to the facility average. The DHIS2 data cleaning process is described in greater detail in the Annex. For most indicators, except cohort retention, less than 0.1% of data points were dropped. For cohort retention, changes to reporting in 2015 contributed to a large amount of bad data (<1% or >100% retention), and 11% of data points were flagged.

Table 18: Numbers of Facilities and Observations in Analysis

	PEPFAR Facilities	**Facilities in DHIS2**	**Observations**	
HMIS Form	**Total**	**Enough data for analysis**[1]	**Total**	**Enough data for analysis**[1]
105 (Monthly)	1,153	1,006	55,153	50,563
106a (Quarterly)		482	18,632	8,194

[1] Facilities were considered as having enough data for analysis is they had two reports from the pre-transition period and two from the post-transition period.

There is no distinction between missing and null in DHIS2. Therefore, a missing field on a submitted report is ambiguous. It may mean that no services or events occurred during the period or that the service was provided but was not entered. For consistency, I imputed zero in all cases when a valid report was submitted with a missing field. However, for OPD, any facility with zero reported OPD visits was excluded from the analysis of OPD, as zero OPD visits is inconsistent with a functioning health facility. Facilities that have no events (all zeroes) for the outcome are excluded from the analyses by default. For facility deliveries, I also excluded facilities that report an average of ≤1 delivery per month (≤4 per month in models with confounders) in order to achieve model convergence.

For objective 2, changes over time in the indicators among transition facilities were compared to the corresponding changes for maintenance facilities in a standard difference-in-difference analysis (hereafter "D-in-D" for short). The D-in-D approach may be used to estimate the causal effect of transitioning on transitioned facilities (i.e. average treatment effect on the treated), if three assumptions are met: 1) parallel baseline trends across the comparison groups, 2) the exposure status (i.e. a facility being selected for transition) is unrelated to the pre-exposure trends, and 3) no interaction between units (i.e. spillover effects) (113). When these assumptions are not met, the D-in-D results should not be interpreted as causal effects; however, the results still provide an informative comparison of the exposure groups, with some caveats. Each assumption is addressed below.

First, the assumption of parallel trends was visually inspected for each indicator and found to apply mainly to indicators that are expected to change very slowly over time, which were proportion indicators, e.g. ANC4+ coverage. An alternative analysis strategy, Trend analysis (described below), was applied to the indicators that visually violated the parallel trend assumption.

The second assumption, that selection of facilities is not made based on variables that predict trends, is valid for non-HIV indicators, which were not used to select transition sites. However, this assumption does not hold for HTC and current on ART, which were used to select "low-volume" facilities for transition; ruling out a causal interpretation of my findings. Selecting facilities for transition on the basis of having a low volume of HIV services may result in transitioned facilities increasing their HIV indicators due to regression to the mean alone. This would favor transition facilities relative to maintenance and bias the estimated effect of treatment.

There is a related concern that potential growth in an indicator is not linear, but rather depends on the baseline level of coverage of the service among the population in need. In practice it is often easier to go from 30% to 50% coverage than to go from 70% to 90% coverage. Comparing facilities at different levels of coverage on a linear metric would penalize better-performing facilities. However, I assumed that a facility's volume of services are primarily constrained on the supply side (i.e. there is always sufficient demand for any increase in supply). Therefore, the ability of facilities to increase an indicator is not constrained by baseline level of coverage in their catchment populations, so long as the assumption holds.

The third criterion, independence of units, may also be violated, as it is possible that patients will switch from transition to maintenance facilities. My assumption that facilities are supply-constrained means that the volume of services is not sensitive to demand for services, and also that changing demand from patients moving from one facility to another will have no net effect on the volume of services delivered. Again, this assumption cannot be supported or refuted with available data. There is evidence to suggest that, at least for some services, demand factors (e.g. seasonal variations in OPD visits related to malaria) do influence volume of services provided, though these may only be seasonal fluctuations to core facility capacity levels and not signal responsiveness to demand over the long-term. Given the potential violations to assumptions required for making a causal interpretation using D-in-D, readers should not take observed estimates as causal effects of transition on transitioned facilities.

To analyze count data, for which baseline trends do vary considerably, I used a difference-in-difference in trend analysis (hereafter referred to as "trend analysis"). Trend analysis compares the change from pre-transition to post-transition slopes of trend lines for transition facilities to the change for maintenance facilities. Doing so controls not only for non-parallel baseline trends but also for secular impacts on trends that are common to maintenance and transition facilities, such as national-level budget changes. I only modeled the linear slope in the pre- and post-periods rather than engaging in more complex modeling of trends because I am primarily interested in the change in slope as a single measure of transition impact.

For count data, I modelled the indicator using a negative binomial model. The negative binomial model is flexible for overdispersion relative to the Poisson distribution. When the outcome is a proportion (i.e. coverage of ANC4+, coverage of IPT2, and 12-month cohort retention), I assess normality of the indicator, controlling for treatment assignment. In no cases did I judge the departure from normality to be large enough for the use linear models with Gaussian standard errors to bias conclusions. Thus, linear models were used to implement the analysis for such indicators using D-in-D analysis. However, I also used bootstrap replication to generate an empirical confidence interval, thereby relaxing the normality assumption used in computation of Gaussian standard errors.

To address autocorrelation in longitudinal data, I applied random intercept (mixed effect) models. Using random intercepts induces an exchangeable correlation structure between observations from the same facility. Since an exchangeable correlation structure may not be suitable for all indicators, I also used a Huber-White sandwich estimator ("vce(robust)" in Stata) to update the autocorrelation model using the empirical autocorrelation function. In addition, I bootstrapped the random intercept models using 500 replications to obtain confidence intervals that are robust to misspecification of the correlation model. The bootstrap is also the recommended way to deal with autocorrelation in D-in-D analysis to reduce the risk of inflating type I errors by Bertrand M, Duflo E, and Mullainathan S (2004) (114).

Transition in Uganda took place over a period of several years. I identified transition time-points in a somewhat arbitrary way, using official start and endpoints reported by USAID as well as observed midpoint in our facility survey sample. By varying the time-point, we can check to see if the observed D-in-D and D-in-D in trend are spurious. In sensitivity analysis for count models, I have displaced the transition midpoint from October 2016 to April 2016, July 2016, and January 2017. For proportion outcomes, I used three different transition windows (October 2014–March 2017, October 2014–December 2016, & January 2015–December 2016) in addition to the preferred window (January 2015–March 2017).

The base model includes seasonal adjustment (except for ART and cohort outcomes, which show little seasonal variation) as well as level & ownership fixed effects. Seasonality has an important influence in health utilization, with low utilization of many outpatient services (ANC, HTC) in December and high utilization of OPD during rainy seasons, associated with malaria incidence. Removing this seasonal influence is important to properly modeling pre- and post-transition trends. The purpose of including level and ownership fixed effects is to improve model fit and the assumption of normally distributed random intercepts by capturing a major source of variation in the fixed effects rather than the random intercepts. These models do not include interactions between facility fixed effects (level, ownership) and post-transition dummies that would be needed to account for confounding by these factors.

For proportion indicators, I modelled a difference-in-difference using transition (vs. maintenance) facility and post-transition (vs. pre-transition) time dummy variables. The D-in-D coefficient on the interaction term for transition x post is the basis for inference. Using trend analysis, I modelled the slope in the pre and post-transition periods for maintenance facilities and include an interaction term for transition facilities. The basis for inference is the difference between the change in slope for transition and the change in slope for maintenance. The models are described in full in the Annex.

Searching for effect measure modification can be an important check for causal attribution. It is possible that D-in-D or trend analysis will be modified by facility characteristics (region, level, ownership). Effect measure modification would imply either that transition from PEPFAR has heterogeneous effects or that there is confounding by factors other than transition. Heterogeneous effects are interesting, but hard to explain, and the more likely explanation will often be residual confounding. I examine effect measure modification by region, facility level, and ownership by repeating the base analysis after disaggregating by region (Central, Eastern, Northern, Western), level (HC II/Clinic, HC III, HC IV/Hospital), and ownership (public, private not for-profit, and private for-profit). I omitted PFPs and HC IIs for ART indicators as few of either provide ART.

3.4 Results

3.4.1 Facility Survey Sample Characteristics

The facility survey obtained results from 226 PEPFAR-supported sites in Uganda. The unweighted characteristics of facilities are presented in (Table 19). Three-quarters of facilities in both maintenance and transition categories were health centre (HC) III level or higher. A total of 73% of facilities offered ART prior to transition and 85% of facilities offered routine deliveries.

The majority of sampled facilities were public (unweighted 70%). Roughly equal proportions of facilities were private for-profit (PFP) and private not for-profit (PNFP). However, many PFPs were caught-up in the "low-volume" component of the GP and relatively fewer PNFPs were transitioned. The majority of both transition and maintenance facilities reported receiving support from PEPFAR IPs for multiple services at baseline: 65% reported receiving assistance for supervision, outreach, training, and laboratory, and 22% reported receiving three of the four services (not shown).

Almost one-third of the transition facilities in our sample were located in the "central support districts" identified by PEPFAR. However, more than 40% of maintenance facilities were located in the central support districts as well, where all facilities were expected to have been transitioned. Many facilities that we expected to report maintenance actually reported their status as transition, and it also appears that PEPFAR IPs in central support districts also decided to extend or retain support for a small number of facilities.

Table 19: Unweighted Facility Characteristics in Survey Sample

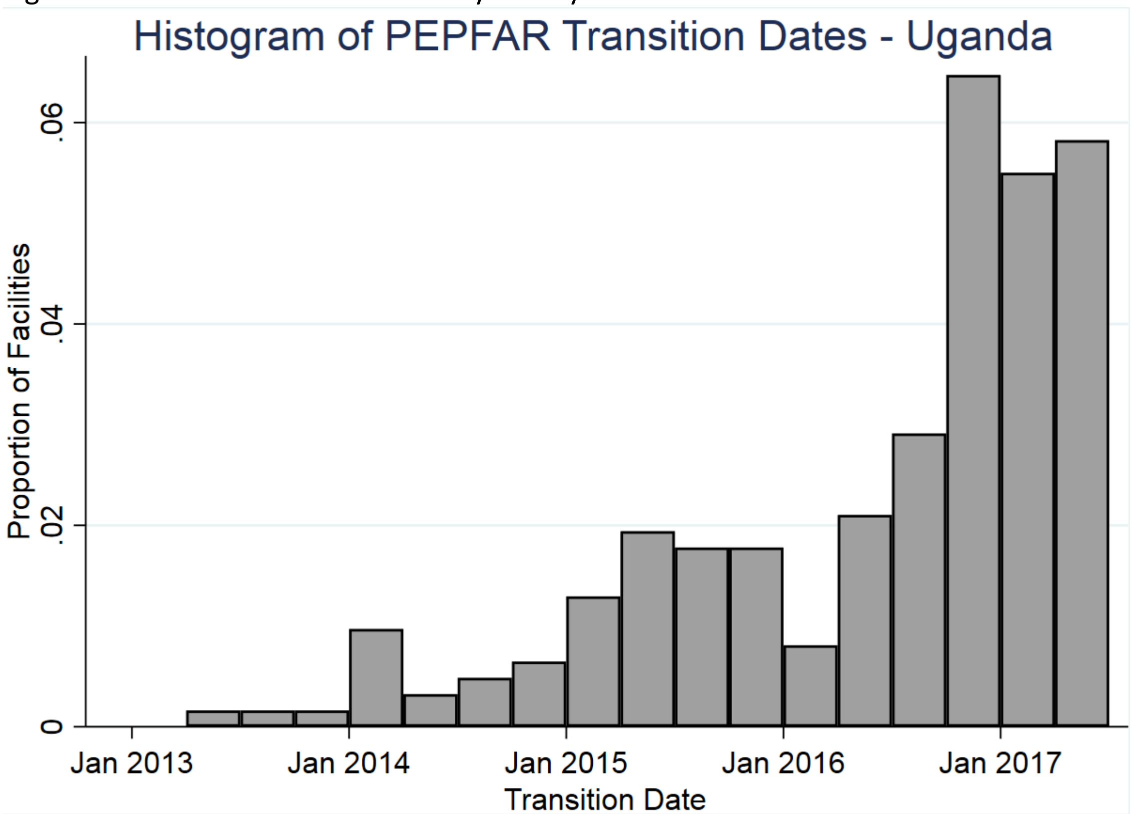
	Transition		Maintenance	
	No.	**%**	**No.**	**%**
Facility Level				
HC II or N/A	50	24.3%	6	30.0%
HC III	133	64.6%	10	50.0%
HC IV	14	6.8%	1	5.0%
Hospital	9	4.4%	3	15.0%
Facility Ownership				
Private for-profit	32	15.5%	1	5.0%
Public	145	70.4%	14	70.0%
Private not for-profit	29	14.1%	5	25.0%
Services Available				
Offers ART (Yes)	152	74%	16	80%
Offers Deliveries (Yes)	176	85%	17	85%
PEPFAR District Classification				
Maintenance	98	47.6%	9	45.0%
Priority	42	20.4%	3	15.0%
Central Support	66	32.0%	8	40.0%
Year of Transition				
2013 – 2014	18	8.7%	n/a	n/a
2015 – 2016	118	57.3%	n/a	n/a
Jan – May 2017	70	34.0%	n/a	n/a
Total	206		20	

Footnote: ART: anti-retroviral therapy; HC: health centre; n/a: not applicable.

The transition of facilities in our survey sample appeared to occur in three waves. The first wave in 2013–2014 consists of facilities that were dropped prior to the formal start of the GP in October 2015. However, these facilities were identified by USAID as part of the GP. Major transition activity did not take place until 2015–2016, and by October 2016, half of transitions had taken place. Late transitions taking place in early 2017 were often supported by Management Sciences for Health/Strengthening TB & HIV/AIDS Responses – Eastern Uganda (MSH/STAR-E), which closed operations in March/April 2017 following a six-month contract extension. Some of the facilities dropped by MSH/STAR-E represent genuine transitions, while others are expected to begin receiving support from the Regional Health Integration to Enhance Services in

Eastern Uganda (RHITES-E) project, which will provide integrated support. It is not clear whether HIV programs will be supported by RHITES-E to the extent that they were under STAR-E.

Figure 10: Transition Dates in Facility Survey



3.4.2 Objective 1: Discontinuation of Services

In-charge respondents reported substantial discontinuation of only one HIV service: HIV outreach (Table 20). Among facilities that provided outreach prior to transition, 51.6% of transition facilities discontinued outreach, compared to only 4.1% of maintenance facilities. No MNCH services were discontinued by more than a handful of facilities, and there were no significant differences in the proportions of transition and maintenance facilities discontinuing any MNCH service. Among facilities having all services at baseline, 16.6% of transition facilities and 0% maintenance facilities have discontinued any MNCH service (p=0.070).

Table 20: Discontinuation of HIV and non-HIV Services

Service	Weighted Proportion Discontinuing		Weighted χ2 P-value	Unweighted Fisher's Exact Test P-value	N
	Transition	Maintenance			Transition, Maintenance
HIV Services					
ART	1.3%	0%	0.333	0.413	149, 15
Outreach	51.6%	4.1%	<0.001	<0.001	175, 19
PMTCT	4.2%	0%	0.372	0.297	175, 19
HTC	2.7%	0%	0.265	0.289	201, 19
MNCH Services					
ANC	2.3%	0%	0.451	0.346	189, 18
Delivery	3.1%	0%	0.449	0.352	176, 16
Immunization	5.1%	0%	0.361	0.302	190, 20
Nutrition	4.4%	0%	0.237	0.270	151, 16
Child	0%	0%	N/A	N/A	177, 18
Any MNCH Service	16.6%	0%	0.070	0.364	137, 14

Footnote: ART: anti-retroviral therapy; ANC: antenatal care; HTC: HIV testing & counseling; MNCH: maternal, neonatal & child health; PMTCT: prevention of mother-to-child transmission.

3.4.3 Objective 2: Perceptions of Patient Access and Service Quality

In-charge respondents in transition facilities were more likely to report worsening patient access for both HIV and MNCH care than in maintenance facilities (Table 21). They are also more likely to report that quality was deteriorating. The differences in proportions were greater for HIV care than for MNCH. Although transition in-charges were more likely to report negative outcomes, in no case did the majority do so.

Table 21: In-Charge Reported Change in Access and Quality of Care

Outcome	Weighted Proportion of Facility In-charges Reporting Worsening		Weighted X^2 p-value	Unweighted Fisher's Exact Test p-value	N
	Transition	Maintenance			(Transition, Maintenance)
HIV access (average patient)	43.5%	3.1%	<0.001	<0.001	204, 19
MNCH access (average patient)	23.9%	0.0%	<0.001	<0.001	198, 19
HIV quality	35.6%	0.0%	<0.001	0.008	204, 19
MNCH quality	19.8%	5.1%	<0.001	<0.001	198, 19

Footnote: HTC: HIV testing & counseling; MNCH: maternal, neonatal & child health.

For specific services, transition facility in-charges were more likely to report that the quality of specific HIV services that they were providing were declining (Table 22). Maintenance facilities generally report that their services were improving. Many transition facilities report improvement as well, but the differences in proportions are large, worse for transition, and statistically significant in all cases.

Table 22: Change in Quality of Specific HIV and non-HIV Services

HIV Services	Weighted Proportion Reporting Worse Quality		Weighted χ2 P-value	Unweighted Fisher's Exact Test p-value	N (Transition, Maintenance)
	Transition	Maintenance			
ART	44.5%	14.9%	<0.001	<0.001	147, 15
Outreach	46.5%	13.9%	<0.001	<0.001	84, 15
PMTCT	36.4%	8.7%	<0.001	<0.001	170, 19
HTC	42.0%	0.0%	<0.001	<0.001	195, 19
MNCH Services	**Weighted Proportion Reporting Better Quality**		**Weighted χ2 P-value**	**Unweighted Fisher's Exact Test p-value**	**N (Transition, Maintenance)**
ANC	33.5%	70.1%	0.001	<0.001	185, 18
Delivery	38.0%	85.8%	<0.001	<0.001	172, 16
Immunization	46.4%	83.3%	<0.001	0.005	185, 20
Nutrition	28.7%	69.9%	<0.001	0.001	145, 16
Child Health Clinic	32.7%	76.8%	<0.001	<0.001	177, 18

Footnote: ART: anti-retroviral therapy; ANC: antenatal care; HTC: HIV testing & counseling; MNCH: maternal, neonatal & child health; PMTCT: prevention of mother-to-child transmission.

3.4.4 Objective 3: Effects on Service Volume

Table 23 presents the results of the ITT analysis of DHIS2 data trends using a transition date of October 2016 for trend analysis and a transition window of Jan 2015–March 2017 for D-in-D. The full models are presented in Table 45 & Table 46 in the Annex. Two findings favored transition facilities: HTC and New on ART. One significant finding favored maintenance: ANC4+ coverage.

Table 23: Trends in Service Delivery (ITT Analysis)

Service Indicator	Freq.	Maintenance		Transition		D-in-D (95% C.I.)[1]	Robust P-value	N Fac.	N Obs.
Trend Analysis		Pre	Post	Pre	Post				
HTC[2]	Monthly	0.3%	-0.3%	-0.8%	1.7%	**3.1% (1.6%, 4.7%)**	<0.001	989	49,187
New on ART	Quarterly	-2.0%	7.1%	-5.5%	9.9%	**6.4% (1.3%, 1.6%)**	0.012	482	7,591
Current on ART	Quarterly	8.3%	5.5%	8.2%	6.6%	1.2% (-2.4%, 5.0%)	0.518	482	7,858
OPD[2]	Monthly	0.0%	-0.7%	0.0%	-0.6%	0.1% (-0.5%, 0.6%)	0.843	989	48,984
ANC Total[2]	Monthly	0.3%	0.1%	0.3%	0.9%	0.8% (0.009, 1.016)	0.072	989	49,192
Facility Deliveries[2]	Monthly	0.8%	0.4%	0.8%	1.2%	0.8% (-0.3%, 1.8%)	0.121	926	46,144
DPT3/Penta-3 Immunization[2]	Monthly	-0.1%	-0.7%	-0.1%	-0.5%	0.2% (-0.4%, 0.9%)	0.496	989	49,195
D-in-D Analysis									
Cohort Retention		81.2%	72.4%	82.3%	69.3%	-4.2 p.p.[3] (-9.6, 1.2)	0.132	465	2,277
ANC4+ Coverage[2]		32.4%	39.0%	36.8%	39.1%	**-4.3 p.p.[3] (-8.2, -0.4)**	0.031	938	19,717
IPT2 Coverage in ANC[2]		25.6%	28.0%	25.7%	27.2%	-0.8 p.p.[3] (-2.6, 0.8)	0.302	939	19,651

[1] All models adjusted for level and ownership
[2] Also adjusted for seasonal variation
[3] Percentage points
Footnote: ART: anti-retroviral therapy; ANC: antenatal care; ANC4+, ratio of 4th or higher order antenatal care visits to 1st visits; DPT3/penta3: DPT3/Penta-3 – diphtheria pertussis tetanus/ pentavalent immunization 3rd dose; HTC: HIV testing & counseling; IPT2 – intermittent prophylaxis therapy 2nd dose; OPD – outpatient department visits.

Relative to maintenance facilities, transition facilities had a 3.1% per month faster change in growth in HTC following transition. Transition facilities also had a higher change in the rate of growth in the number of patients new on ART of 6.4% per quarter. Comparing ANC4+ coverage (ANC4+/ANC1), transition facilities improved less than maintenance facilities. The difference-in-difference for ANC4+ coverage was -4.3 percentage points. It is important to examine trends graphically to understand these changes.

Figure 11: Trends in HTC

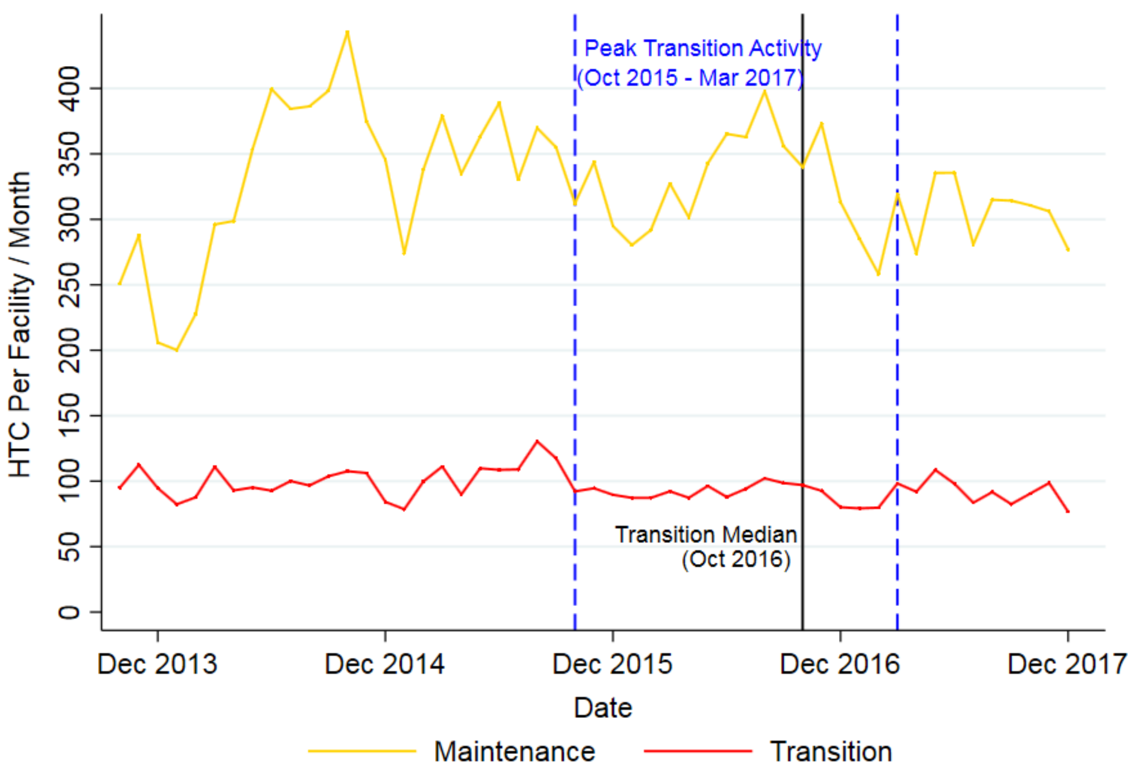
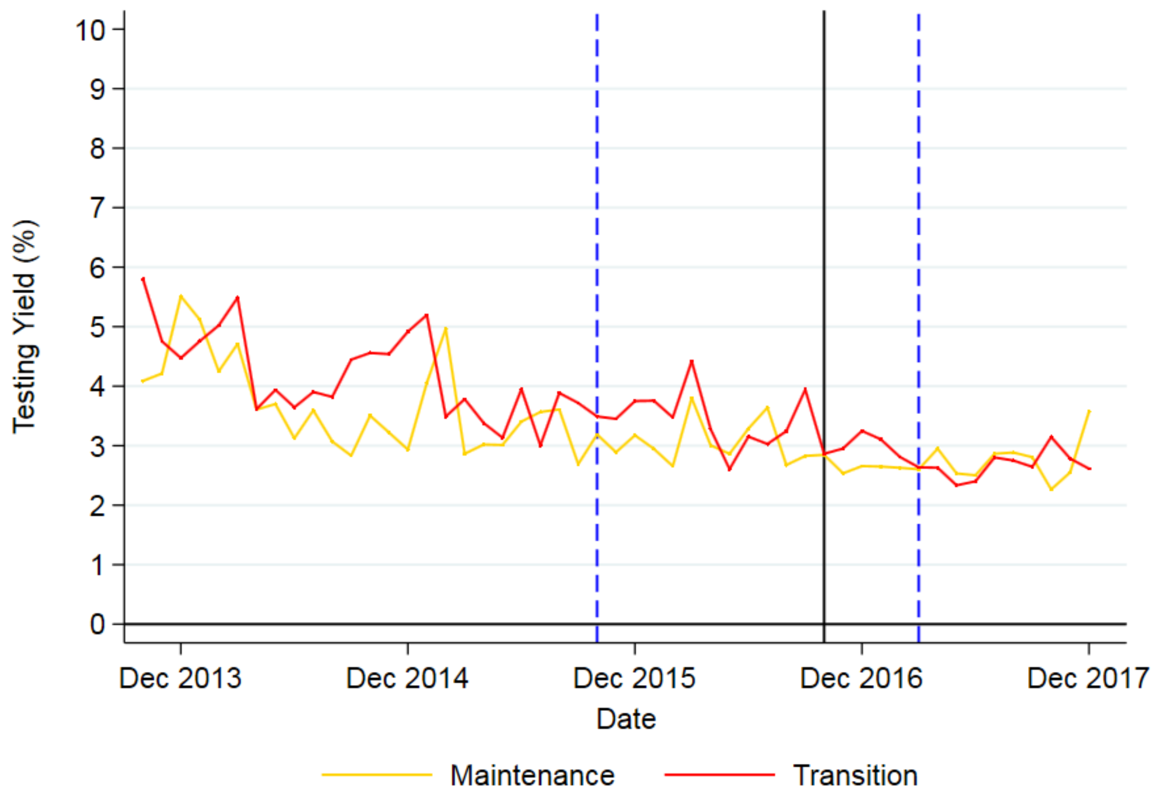


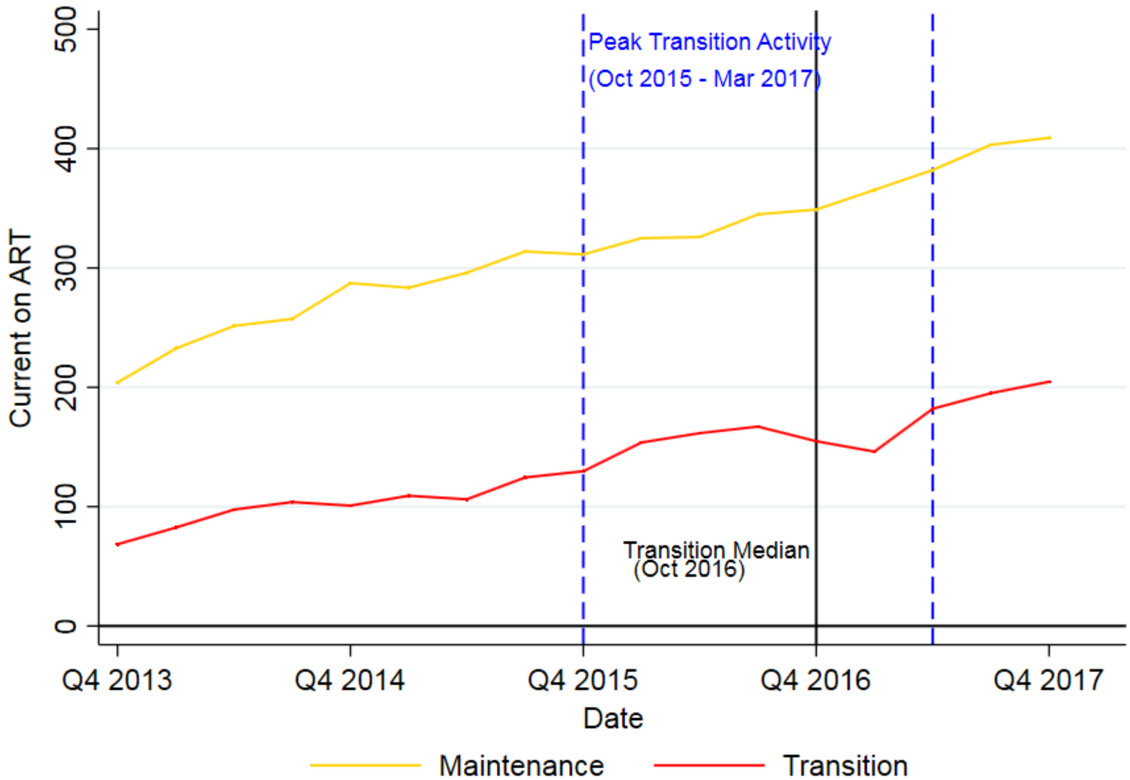
Figure 11 presents the trends in HTC for the study period along with the transition midpoint (solid black line) and the widow of peak transition activity (Oct 2015–Mar 2017). The window of peak transition activity is not the same as the transition window used in the D-in-D analysis (Jan 2015–Mar 2017). An increase in HTC in maintenance facilities in 2014–2015 was not sustained in 2016–2017. Transition facilities experienced a relatively smaller increase and decrease in HTC. Therefore, they have a positive difference-in-difference in trend.

Figure 12: Trends in HTC Yield



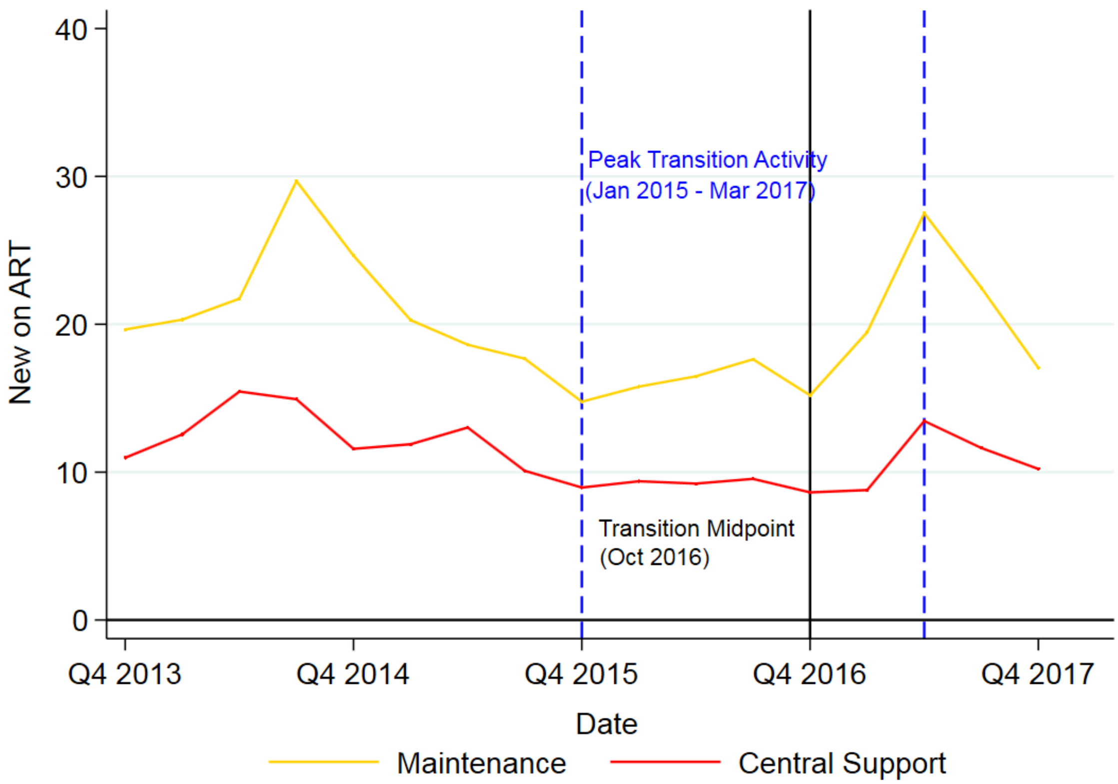
While not an outcome of priority, it is important to note that HTC Yield (the proportion of HIV tests that were positive) did not improve in either category of facility (Figure 12). Therefore, there is little reason to expect that the decline in HTC observed in maintenance is due to improved targeting of HIV+ individuals by maintenance facilities.

Figure 13: Trends in Current on ART



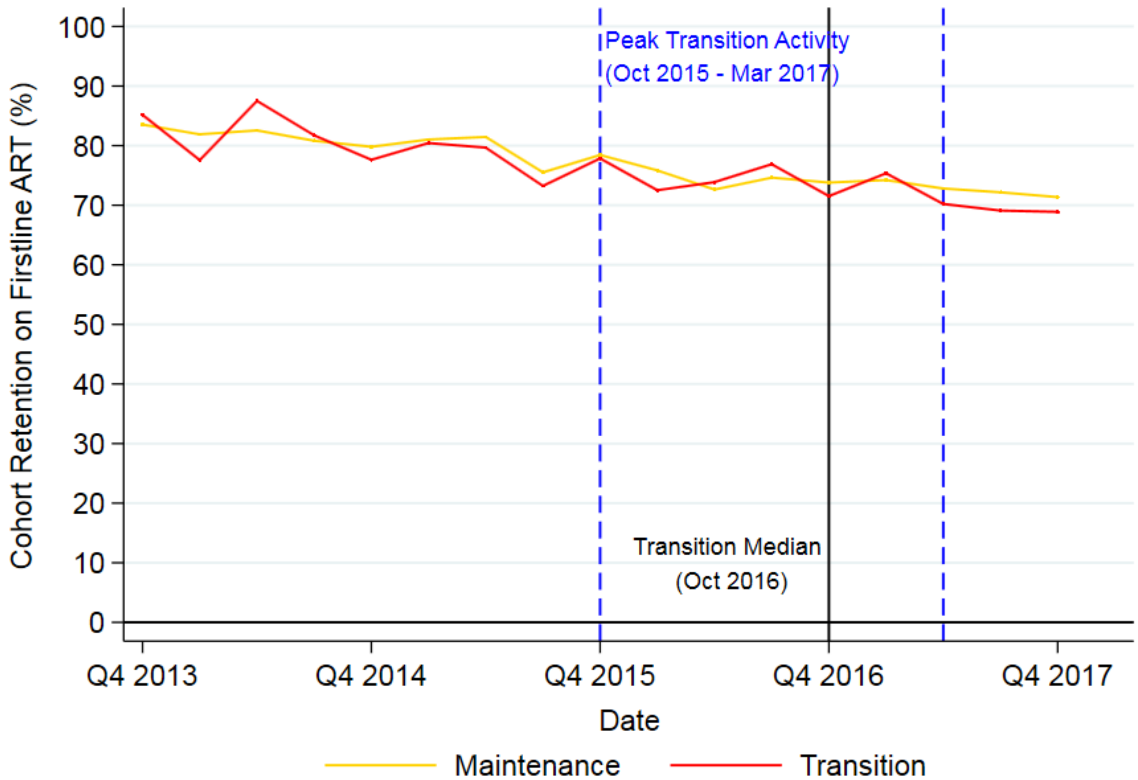
Both transition and maintenance facilities maintained their baseline trajectories in the number of patients currently on ART (Figure 13). The average ART patient load at PEPFAR facilities more than doubled for both facility types between Q12013 and Q42017.

Figure 14: Trends in New on ART



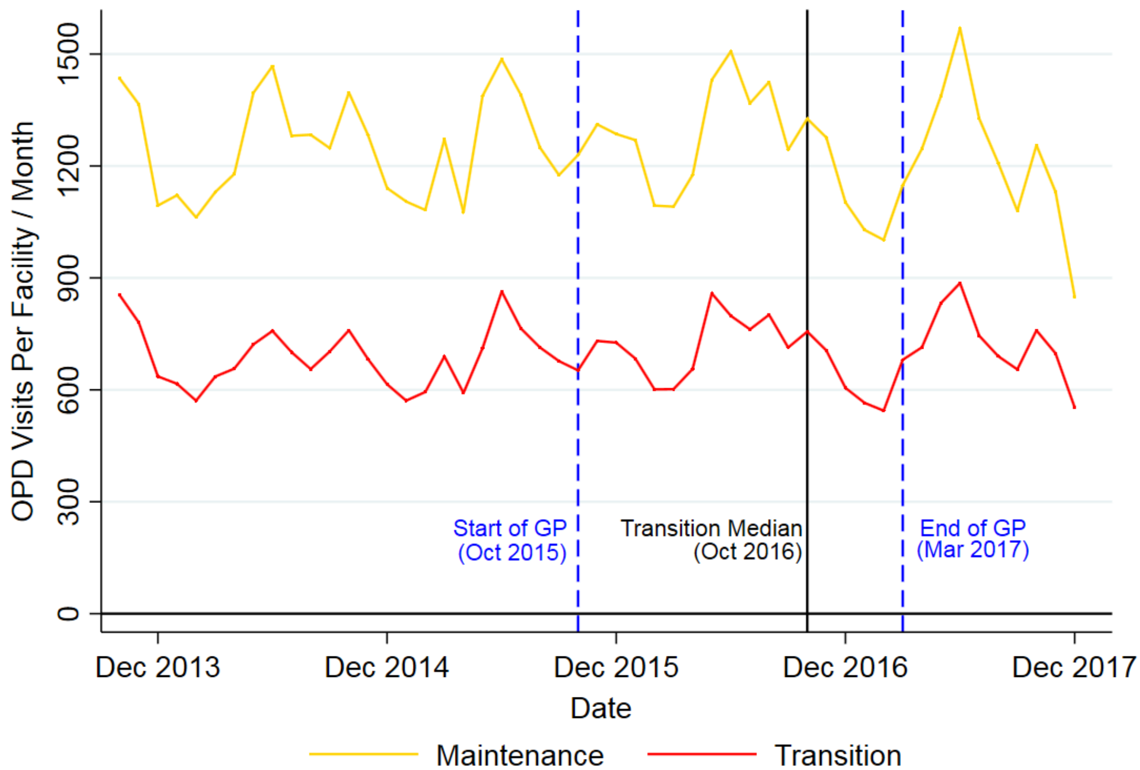
Trends in enrollment of new patients on ART are largely flat with peaks in 2014 and 2017 (Figure 14). The trend analysis model was not intended for such a variable indicator. Transition facilities were able to increase new on ART during the second peak in 2017 at a proportion comparable to maintenance facilities. In fact, transition facilities have a significantly higher difference-in-difference in trend than maintenance facilities by 6.4% per quarter (1.3%, 11.6%). This is largely due to the more stable trend in new on ART in transition compared to the higher variability in maintenance.

Figure 15: Trends in Cohort Retention at 12-months



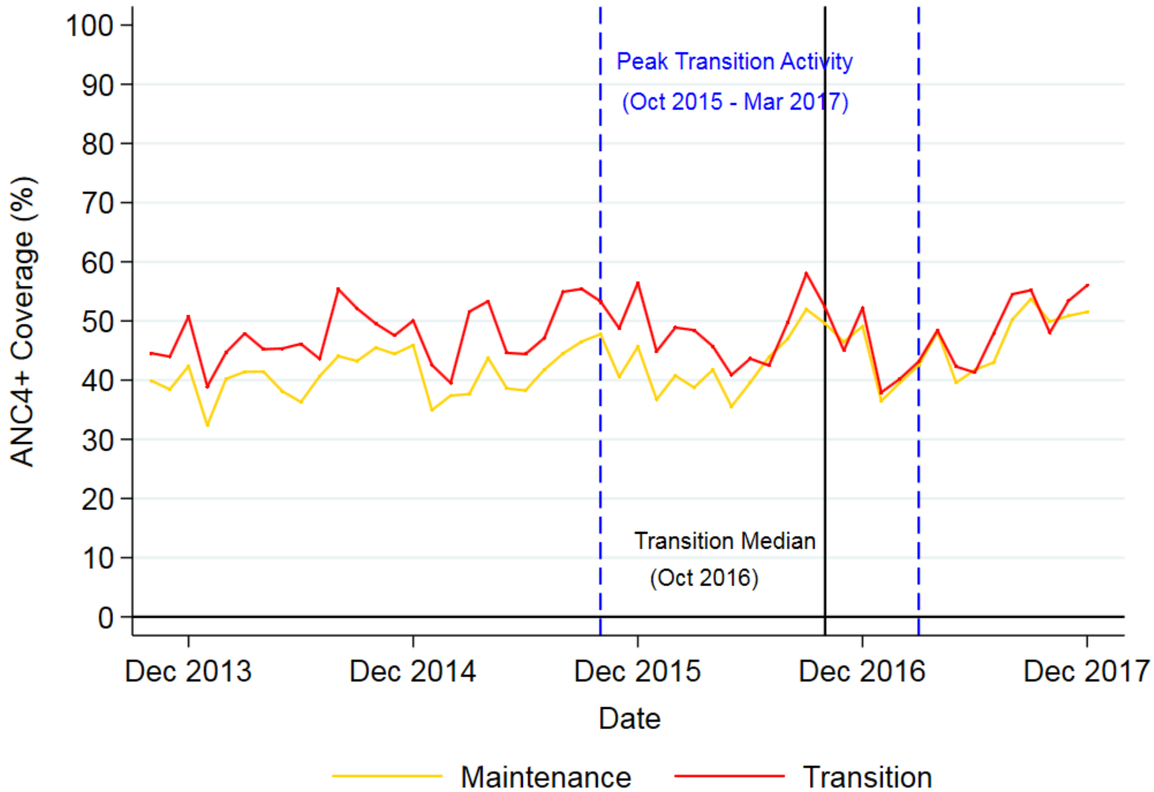
Transition facilities and maintenance facilities have similar levels of retention of patients on first-line ART at 12 months following enrollment on ART (Figure 15). The decline in cohort retention at 12 months is substantial, nearly 15 percentage points between Q4 2013 and Q4 2017, but it does not differ significantly for transition versus maintenance.

Figure 16: Trends in OPD Visits



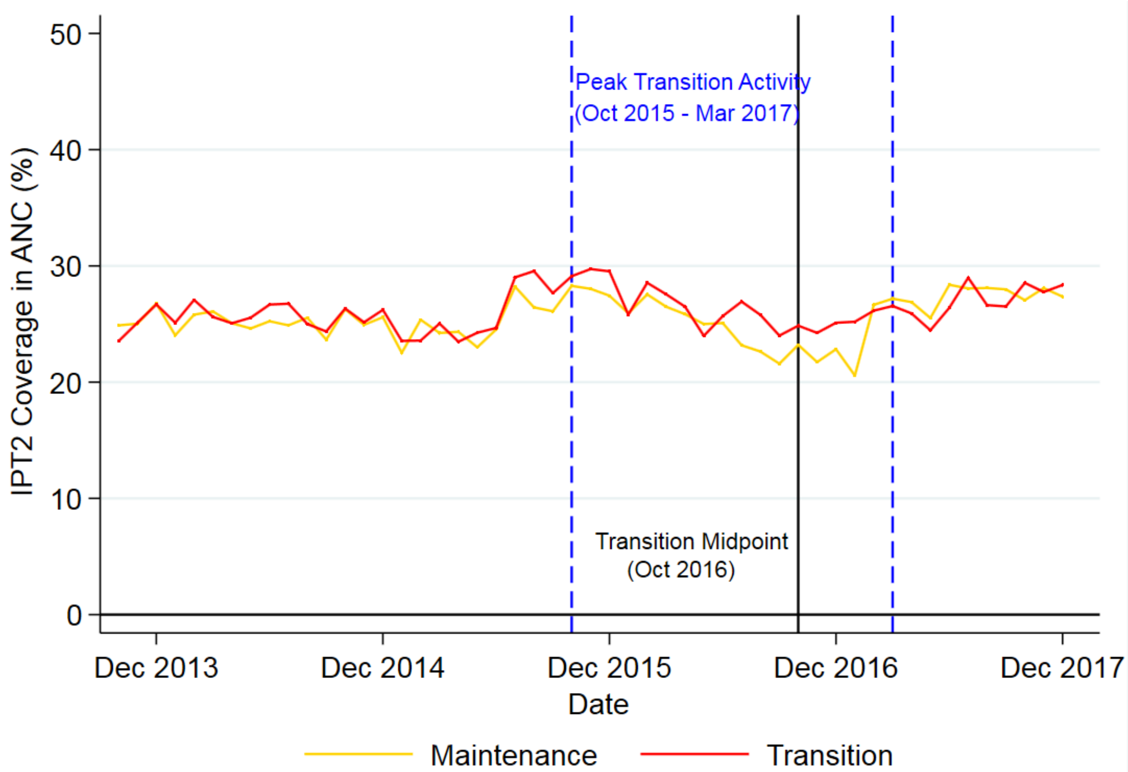
Turning to non-HIV services, trends in OPD visits did not differ significantly between transition and maintenance (Figure 16). Seasonal variation is very important for this indicator. Both facility types have a slight downward trend in OPD.

Figure 17: Trends in Coverage of ANC4+



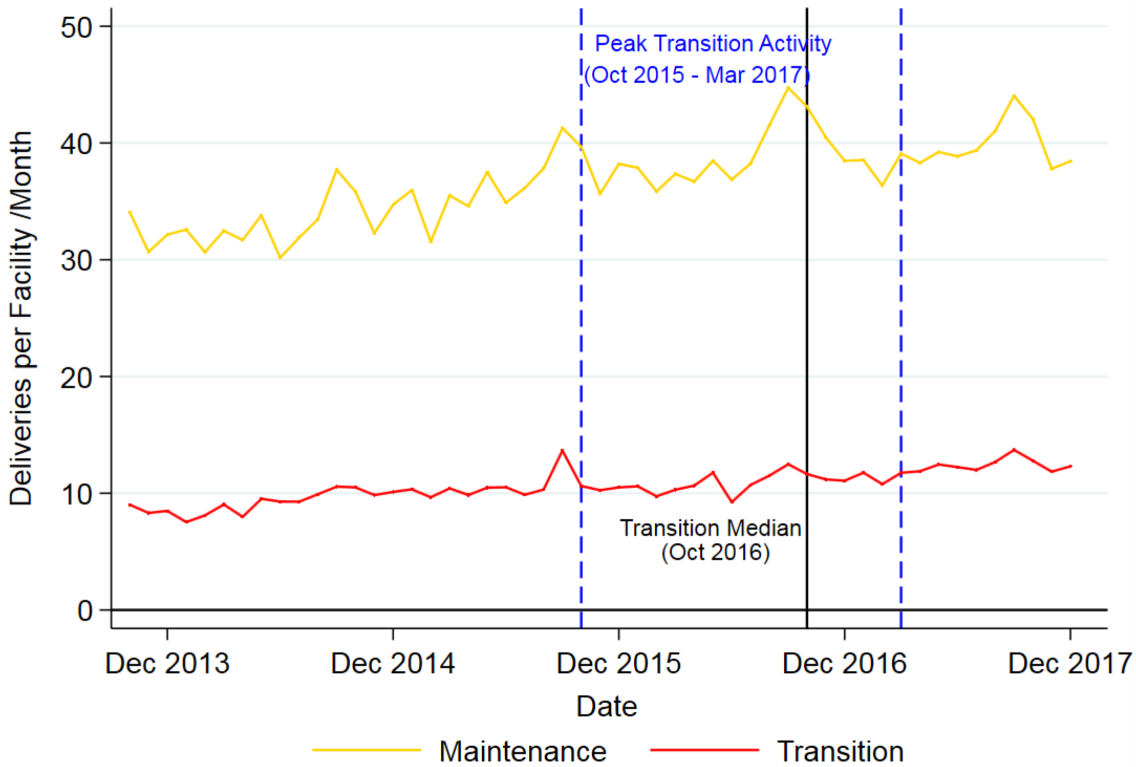
Coverage of 4+ ANC visits during pregnancy increased more for maintenance than for transition over the time-period (Figure 17). The D-in-D is -4.3 percentage points and marginally significant (p=0.031). The closing of the curves seems to be due to less improvement in the indicator among transition facilities than maintenance facilities.

Figure 18: Trends in IPT2 Coverage



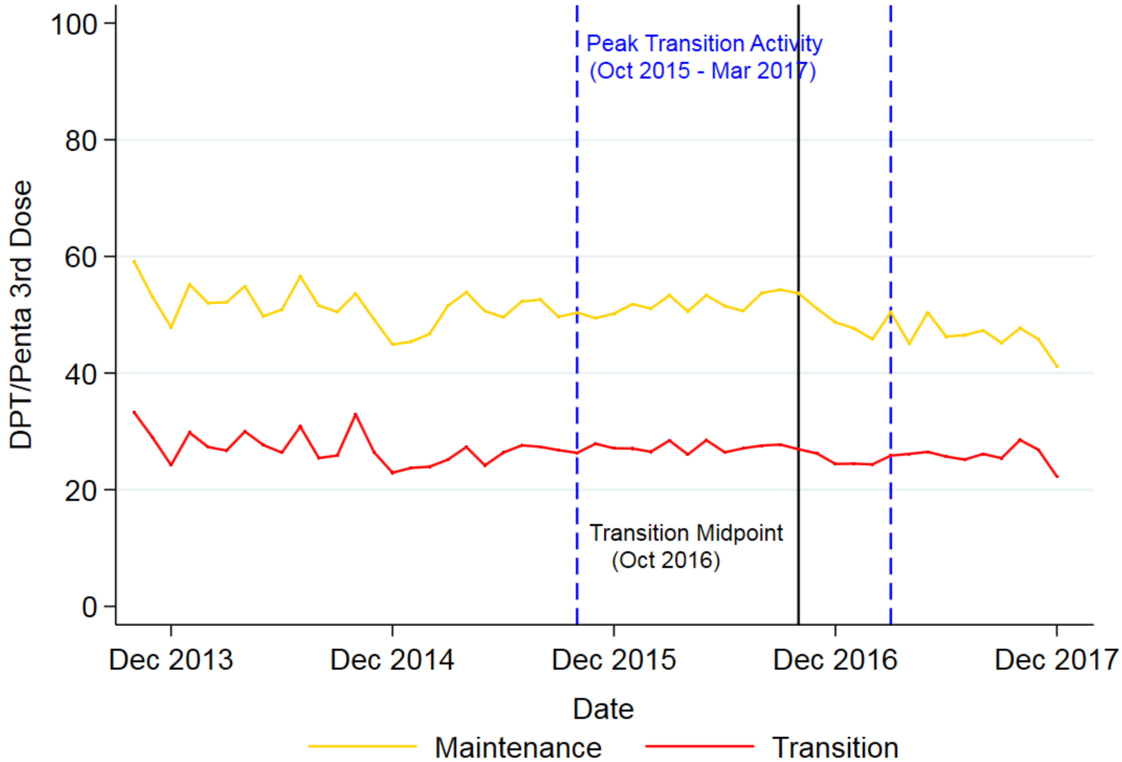
There was no significant D-in-D for IPT2 coverage in ANC (Figure 18). IPT2 coverage in Uganda is fairly low at about 25%–30% but seems to be improving slowly in 2017.

Figure 19: Trends in Facility Deliveries



Facility deliveries have been increasing steadily in both types of facilities (Figure 19). Thus, the difference-in-difference in trend was small and not significant.

Figure 20: Trends in DPT3 or Penta-3 Immunization



There was no significant difference-in-difference in trends for maintenance and transition facilities for DPT3/Penta-3 (Figure 20). However, there is a downward trend in both maintenance and transition facilities.

3.4.5 Secondary Analysis: Using Facility Survey Sample with Self-Reported Transition Indicator

Restricting the data to the facility survey sample results in a considerable reduction in sample size. In particular, the number of maintenance facilities contributing to the analysis is 11 for Current on ART and 10 for Cohort Retention. Using the base model, transition facilities have a significantly higher trend in current on ART (1.7% per quarter; 95% C.I.: 0.1%–3.3%;

p=0.034). For cohort retention, the decline in transition is almost significantly larger than in maintenance (p=0.063).

Table 24: Trends in Service Delivery (Survey Sample)

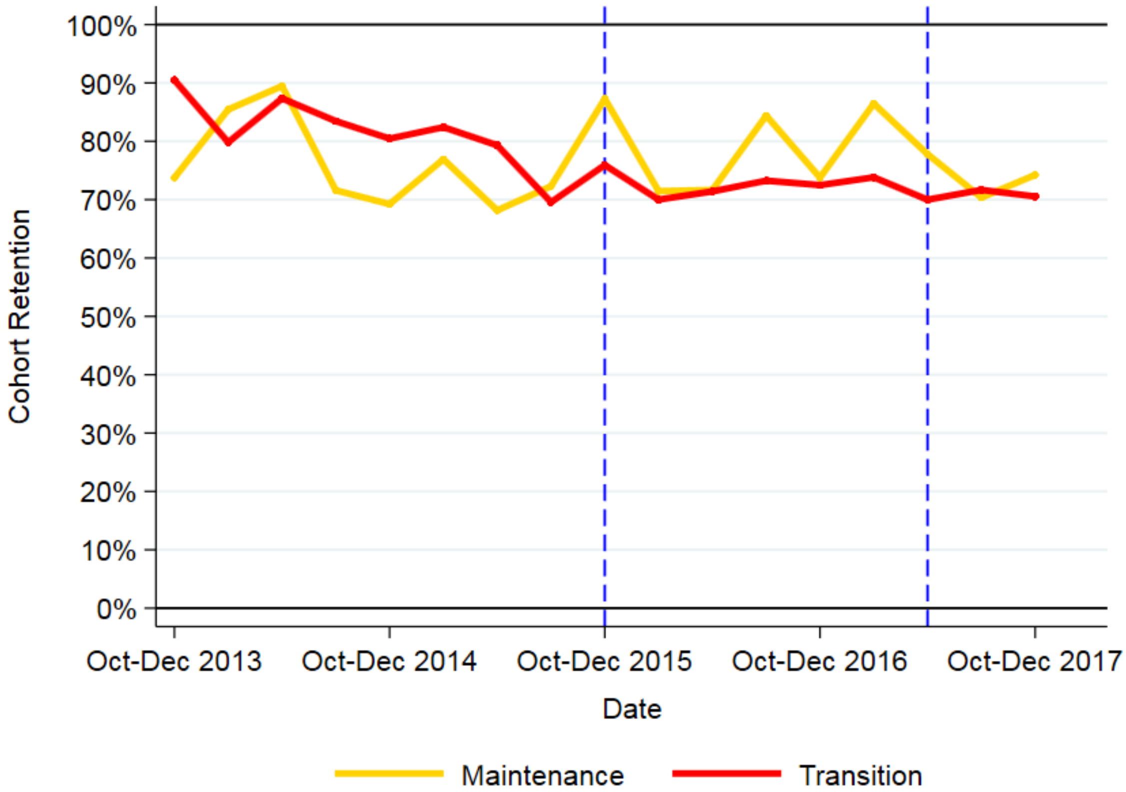
Service Indicator	Freq.	Maintenance		Transition		D-in-D (95% C.I.)[1]	Robust P-value	N Facilities	N Obs.
Trend Analysis		Pre	Post	Pre	Post				
HTC[2]	Monthly	-0.3%	-1.2%	-0.3%	-2.6%	-1.5% (-7.0%, 4.3%)	0.611	207	10,336
New on ART	Quarterly	-3.5%	-1.8%	-2.8%	-1.5%	-0.4% (-2.8%, 2.0%)	0.738	139	2,131
Current on ART	Quarterly	9.4%	6.6%	8.5%	7.5%	**1.7% (0.1%, 3.3%)**	**0.034**	139	2,220
OPD visits[2]	Monthly	-0.3%	-1.1%	-0.3%	-0.7%	0.4% (-1.5%, 2.3%)	0.694	207	10,289
ANC Total[2]	Monthly	1.5%	-1.0%	0.4%	-0.3%	1.7% (-0.7%, 4.1%)	0.152	207	10,336
Facility Deliveries[2]	Monthly	0.6%	0.5%	1.3%	0.1%	-1.1% (-3.3%, 1.3%)	0.372	207	10,338
DPT3/ Penta-3[2]	Monthly	0.0%	0.2%	-0.2%	-0.9%	-1.0% (-3.0%, 1.3%)	0.436	207	10,337
D-in-D Analysis									
Cohort Retention		68.0%	64.3%	75.1%	60.9%	-10.4p.p.[3] (-21.4, 0.6)	0.063	133	626
ANC4+ Coverage[2]		42.2%	47.2%	36.8%	41.7%	-0.1p.p.[3] (-10.4, 10.1)	0.982	199	4,419
IPT2 Coverage in ANC[2]		24.6%	23.4%	24.2%	25.4%	2.4p.p.[3] (-4.2%, 9.0%)	0.472	200	4,378

[1] Adjusted for level and ownership
[2] Also adjusted for seasonal variation
[3] Percentage points
Footnotes: ART: anti-retroviral therapy; ANC: antenatal care; D-in-D: difference-in-difference; DPT3/Penta-3: diphtheria pertussis tetanus/ pentavalent immunization 3rd dose; HTC: HIV testing & counseling; IPT: intermittent prophylactic therapy 2nd dose.

I explore the cohort retention finding in greater depth. Given the small sample size of maintenance facilities, it is possible that a few outliers could influence the result. I include a bootstrap model to test the consistency of the finding for cohort retention under repeat sampling. The resulting D-in-D is -10.4p.p. (-22.2, 1.3; p=0.082). The full model is presented in the Annex

(Table 53). Examining the trends in Cohort Retention graphically (Figure 21), the D-in-D for cohort retention appears to be related to a decline in retention in transition facilities in 2015 & 2016, which precedes transition.

Figure 21: Trends in Cohort Retention (Facility Survey Sample)



3.4.6 Sensitivity Analysis: Sensitivity to Transition Timing

First, I examine sensitivity of findings to timing of the transition timeline that may reflect noise at a specific point in time. Using the basic model described previously, varying the transition midpoints and transition windows does not demonstrate that the conclusions are sensitive to the timing used to model transition (Table 25 & Table 26). Only for the number of total ANC visits using a midpoint of April 2016 did the results change qualitatively from significant to insignificant, although the results are not quantitatively different.

Table 25: Sensitivity to Transition Midpoint, Full Sample (Trend Analysis)

Indicator	D-in-D in Trend:	Oct 2016 (Preferred Model)	July 2016	April 2016	Jan 2017
HTC	*IRR*	**1.031*** **	**1.024*** **	**1.020** **	**1.033*** **
	Robust 95% C.I.	**(1.016, 1.047)**	**(1.010, 1.037)**	**(1.008, 1.033)**	**(1.014, 1.052)**
	p-value	**<0.001**	**0.001**	**0.001**	**0.001**
New on ART	*IRR*	**1.064***	**1.053** **	**1.057** **	**1.065***
	Robust 95% C.I.	**(1.013, 1.116)**	**(1.013, 1.095)**	**(1.013, 1.102)**	**(1.005, 1.129)**
	p-value	**0.012**	**0.008**	**0.010**	**0.035**
Current on ART	*IRR*	1.012	1.003	1.003	1.011
	Robust 95% C.I.	(0.976, 1.050)	(0.974, 1.033)	(0.971, 1.036)	(0.971, 1.052)
	p-value	0.518	0.844	0.850	0.609
OPD	*IRR*	1.001	1.000	1.000	1.002
	Robust 95% C.I.	(0.995, 1.006)	(0.995, 1.005)	(0.996, 1.005)	(0.994, 1.009)
	p-value	0.843	0.961	0.940	0.661
Total ANC Visits	*IRR*	1.008	1.008	**1.008***	1.009
	Robust 95% C.I.	(0.999, 1.016)	(1.000, 1.015)	**(1.001, 1.015)**	(0.999, 1.019)
	p-value	0.072	0.051	**0.034**	0.082
Facility Delivery	*IRR*	1.008	1.006	1.005	1.009
	Robust 95% C.I.	(0.997, 1.018)	(0.997, 1.015)	(0.997, 1.014)	(0.997, 1.021)
	p-value	0.121	0.214	0.244	0.140
DPT3/ penta-3	*IRR*	1.002	1.001	1.001	1.003
	Robust 95% C.I.	(0.995, 1.009)	(0.995, 1.007)	(0.995, 1.007)	(0.995, 1.011)
	p-value	0.496	0.758	0.741	0.438

*p<0.05, **p<0.01, ***p<0.001

Footnotes: ART: anti-retroviral therapy; ANC: antenatal care; D-in-D: difference-in-difference; DPT3/Penta-3: diphtheria pertussis tetanus/ pentavalent immunization 3rd dose; HTC: HIV testing & counseling; IPT: intermittent prophylactic therapy 2nd dose; OPD: outpatient department visits.

Table 26: Sensitivity to Transition Window, Full Sample (D-in-D Analysis)

Indicator	D-in-D in Level:	Jan 2015 – Mar 2017 (Preferred)	Oct 2014 – Mar 2017	Oct 2014 – Dec 2016	Jan 2015 – Dec 2016
ANC4+ Coverage	*Estimate*	**-0.043***	**-0.052***	**-0.054****	**-0.045***
	Robust 95% C.I.	**(-0.082, -0.004)**	**(-0.093, -0.012)**	**(-0.092, -0.016)**	**(-0.082, -0.009)**
	p-value	**0.031**	**0.012**	**0.005**	**0.015**
IPT2 Coverage	*Estimate*	-0.008	-0.009	-0.004	-0.004
	Robust 95% C.I.	(-0.025, 0.008)	(-0.025, 0.008)	(-0.020, 0.012)	(-0.020, 0.011)
	p-value	0.302	0.314	0.610	0.588
Cohort Retention	*Estimate*	-0.042	-0.052	-0.043	-0.033
	Robust 95% C.I.	(-0.096, 0.013)	(-0.110, 0.007)	(-0.097, 0.010)	(-0.084, 0.018)
	p-value	0.132	0.082	0.110	0.202

*p<0.05, **p<0.01, ***p<0.001

Footnotes: ART: anti-retroviral therapy; ANC: antenatal care; D-in-D: difference-in-difference; DPT3/Penta-3: diphtheria pertussis tetanus/ pentavalent immunization 3rd dose; HTC: HIV testing & counseling; IPT: intermittent prophylactic therapy 2nd dose.

3.4.7 Sensitivity to Effect Measure Modifiers: Region, Level, and Ownership

Next, I examine effect measure modification by region. Region modifies the difference-in-difference in trend for several indicators (Annex: Table 47 & Table 48). The significant positive association between transition and relative trends in HTC can be attributed to Northern and Western Uganda only. New on ART is significantly primarily due to the associations found in Northern and Western Uganda; the association is not significant for Central and Eastern Uganda. A positive D-in-D in trend for Total ANC and DPT3 is noted for Western Uganda only. Cohort retention declined significantly more in transition facilities in Central and Western Uganda, but no significant effect was seen in Eastern and Northern Uganda.

Health facility level modifies the association for only one count indicator. The difference-in-difference in trend is significant for New on ART only for HC III and not among HC IV & Hospitals (Annex: Table 49). The significant and negative D-in-D for ANC4+ is only observed in HC IIs (Annex: Table 50). For IPT2, there is no significant D-in-D at any level of facility. Cohort retention has a larger negative D-in-D in HC IVs & Hospitals than in HC IIIs, but the difference is not statistically significant (Annex: Table 50).

Ownership modified the association for HTC, where the positive D-in-D in trend seen in public and PNFP facilities is not noted in PFPs. I examine effect modification more directly for PFPs in the third paper of this thesis. For New on ART, there was no significant D-in-D in trend for PNFPs but a positive effect in public facilities (Annex: Table 51). The association between transition and reduced ANC4+ is modified by ownership. The D-in-D for ANC4+ is large and negative for PFPs: -0.201 (95% C.I.: -0.424, 0.022; p=0.077), but not significant. For public and PNFPs, the D-in-D is much smaller. The D-in-D in IPT2 coverage is significant for public facilities only (Annex: Table 52).

3.4.8 Sensitivity to Model Misspecification: Bootstrap

Bootstrap confidence intervals are not sensitive to misspecification of either the distribution of the dependent variable or the autocorrelation model. The bootstrap confidence intervals in Table 27 & Table 28 are similar to the robust confidence intervals for the preferred model. Using the bootstrap does not change any of the interpretations.

Table 27: Bootstrap Confidence Intervals for Count Models (Trend Analysis)

Indicator	D-in-D in Trend	Preferred Model (Robust C.I.)	Preferred Model (Bootstrap C.I.)
HTC	*IRR*	**1.031*** **	**1.031*** **
	95% C.I.	**(1.016, 1.047)**	**(1.016, 1.047)**
	p-value	**<0.001**	**<0.001**
New on ART	*IRR*	**1.064***	**1.055***
	95% C.I.	**(1.013, 1.116)**	**(1.011, 1.100)**
	p-value	**0.012**	**0.013**
Current on ART	*IRR*	1.012	1.009
	95% C.I.	(0.976,1.050)	(0.980, 1.040)
	p-value	0.518	0.539
OPD	*IRR*	1.001	1.001
	95% C.I.	(0.995, 1.006)	(0.994, 1.007)
	p-value	0.843	0.854
Total ANC Visits	*IRR*	1.008	1.008
	95% C.I.	(0.999, 1.016)	(0.999, 1.016)
	p-value	0.072	0.076
Facility Delivery	*IRR*	1.008	1.008
	95% C.I.	(0.997, 1.018)	(0.998, 1.018)
	p-value	0.121	0.123
DPT3/penta-3	*IRR*	1.002	1.002
	95% C.I.	(0.995, 1.009)	(0.996, 1.009)
	p-value	0.496	0.505

*p<0.05, **p<0.01, ***p<0.001

Footnotes: ART: anti-retroviral therapy; ANC: antenatal care; D-in-D: difference-in-difference; DPT3/Penta-3: diphtheria pertussis tetanus/ pentavalent immunization 3rd dose; HTC: HIV testing & counseling; OPD: outpatient department visits.

Table 28: Bootstrap Confidence Intervals for D-in-D models

Indicator	D-in-D	Preferred Model (Robust C.I.)	Preferred Model (Bootstrap C.I.)
ANC4+ Coverage	*Estimate*	**-0.043***	**-0.043***
	95% C.I.	**(-0.082, -0.004)**	**(-0.083, -0.004)**
	p-value	**0.031**	**0.032**
IPT2 Coverage	*Estimate*	-0.008	-0.008
	95% C.I.	(-0.025, 0.008)	(-0.025, 0.008)
	p-value	0.302	0.323
Cohort Retention	*Estimate*	-0.042	-0.042
	95% C.I.	(-0.096, 0.013)	(-0.096, 0.013)
	p-value	0.132	0.133

*p<0.05, **p<0.01, ***p<0.001

Footnotes: ANC: antenatal care; D-in-D: difference-in-difference; IPT: intermittent prophylactic therapy 2nd dose.

3.5 Discussion

In transitioned health facilities in Uganda, health workers report discontinuation of HIV outreach and worsening patient access and quality of care. However, there is a contradiction between reports by facility respondents and secondary data on services. DHIS2 service delivery indicators do not reveal a decline in service volume in transition. Transition facilities have sustained HTC better than maintenance facilities. Trends in current on ART are similar for both facilities. While one would expect the reported discontinuation of outreach to worsen cohort retention, the decline in cohort retention is similar for maintenance and transition facilities in the ITT analysis. In the survey sample analysis, the change in cohort retention is a nearly significant 10.4 percentage points lower for transition than for maintenance. However, the divergence appears to begin prior to the official beginning of PEPFAR GP and is based on data from only 10 maintenance facilities.

For non-HIV services, there is also a contrast between the lower proportion of in-charges reporting improvement in access and quality of MNCH care in transition, on the one hand, and the lack of differences-in-difference in trend in DHIS2, on the other hand. Only for ANC4+ were transition facilities worse off.

In trying to reconcile the discrepancy between data sources, I consider two possible explanations. First, facility in-charges may be exaggerating the impact of transition reported in our survey. In-charges may be deliberately trying to influence the findings to show transition in a negative light, or they may be unintentionally underestimating their own facilities' and patients' ability to adjust to changes. While the survey is retrospective, it also takes place at only one point in time, in July and August 2017, and the mood of transition facility respondents may have been particularly pessimistic at that time.

The second possible explanation is that I may be missing important changes in service delivery due to limitations in the data or methodology used. Most indicators are volume-based, and do not capture quality of services. Even coverage indicators (i.e. coverage of ANC4+, coverage of IPT2, cohort retention) are rough measures that do not truly capture the quality of care, much less patient satisfaction. Secondly, with only 15 months of data following the assumed midpoint of transition activity, many of the impacts of transition may not yet be apparent in DHIS2. Transition from PEPFAR has affected supervision, incentives for health workers, training, and outreach. It may take time for these impacts to translate into lower capacity or quality of care. Facilities also may be benefiting from past investments in systems and infrastructure that temporarily blunt the short-term loss of ongoing support.

Lastly, there may be clinically meaningful (albeit statistically insignificant) changes in services that I do not have the power to detect with available data. Treating the coefficients for difference-in-difference in trend as an approximation of the percentage change in services per unit time, the cumulative 1-year difference implied by the robust confidence intervals are fairly large. For example, the 95% confidence intervals for Current on ART (-3.7%, 2.7% per quarter) imply that transition facilities could have -14.0% to +11.3% difference-in-difference in the number of patients current on ART after one year — a very wide confidence interval. I would consider a relative decline of 10% in current on ART as programmatically significant, which falls well within the bounds created from robust confidence intervals. That said, were there many negative impacts of transition, it is unlikely that I would observe only one negative point estimate (ANC4+) and several significant, positive point estimates.

Table 29: Projected Differences in Service Volume at 12 months following Transition (ITT Analysis)

Service Name	Method	Robust Confidence Interval	95% Lower Bound Relative Difference	95% Upper Bound Relative Difference
HTC	Trend	(1.1%, 4.7%) per month	14.0%	73.5%
New on ART	Trend	(1.0%, 11.3%) per quarter	4.1%	53.5%
Current on ART	Trend	(-3.7%, 2.7%) per quarter	-14.0%	11.3%
OPD	Trend	(-0.5%, 0.6%) per month	-5.8%	7.4%
Facility Deliveries	Trend	(-0.3%, 1.7%) per month	-3.5%	22.4%
DPT3/Penta-3 Immunization	Trend	(-0.5%, 1.0%) per month	-5.8%	12.7%

Footnotes: ART: anti-retroviral therapy; ANC: antenatal care; D-in-D: difference-in-difference; DPT3/Penta-3: diphtheria pertussis tetanus/ pentavalent immunization 3rd dose; HTC: HIV testing & counseling; OPD: outpatient department visits.

For the proportion indicators, I consider a decline of 5p.p. as programmatically significant. This was not achieved for any point estimate, but robust 95% confidence intervals include a change of -5p.p. in cohort retention and ANC4+ coverage. Therefore, it is possible that meaningful impacts of transition could have occurred, but I lack statistical power to detect them.

The existence of variations in the measure of association for OPD, ANC, and HTC by region, level, and/or ownership adds to the need for caution when making causal interpretations. Were transition to explain observed associations for all outcomes, we would either expect that 1) transition would have a consistent effect across regions, levels, and ownership categories; or 2) that there were mediating factors across groups that could affect how transition's impact is experienced differently. The variations observed across regions, levels, and ownership suggest that the significant associations are far more likely to be caused by geographically or institutionally differing trends in utilization across facilities rather than by transition. I will examine effect mediation for by ownership for HIV indicators in the third paper in this thesis.

Unrelated to transition, there has been a major increase in the number of patients on ART but a concurrent decline in cohort retention. The secular decline in cohort retention was also noted in UNAIDS estimates, which show retention dropping from 85% in 2014 to 78% in 2017 (115). UNAIDS produces a national-level estimate, whereas I report facility-level averages without weighting. The decline in retention seems to be genuine and requires attention.

3.5.1 Limitations

There were several limitations to this study. As noted previously, the facility survey relied on self-report and respondent recall. Therefore, our findings are subject to response and recall bias. These biases could influence our findings if transition facility in-charges were more likely to recall or report true negative outcomes than maintenance facilities. Furthermore, we conducted the facility survey only in 28 districts of Uganda that were selected out of 42 possible districts in our sample area, which is a subset of 112 districts nationally. Therefore, our facility survey is not nationally representative.

The DHIS2 data has known issues with completeness. Among maintenance and transition PEPFAR facilities, 1,006 out of 1,153 facilities (87.3%) had enough data in DHIS2 for HMIS 105 indicators (e.g. HTC, ANC, facility deliveries). It is not known how many facilities should be reporting HMIS 106a; however, from the facility survey, I found that only 73% of facilities that reported providing PMTCT or ART made the minimum number of HMIS 106a reports to be included in the analysis. It is likely that reporting facilities are systematically different from non-reporting facilities. However, in order for incomplete reporting to bias the findings, the difference-in-differences would need to vary systematically between reporting and non-reporting facilities. This is less likely, though still possible.

Inaccuracies in DHIS2 data are also probable. My efforts to remove a small number of extreme outliers likely did little to address poor quality data. Imputation of missing as zero, while necessary to address ambiguous reporting forms, may have further biased the findings. However, due to the difference-in-difference/trend analysis design, only differential changes in data quality could bias our findings. Yet, differential data quality change is quite likely. PEPFAR IPs are supposed to continue annual data quality visits, but this may not be enough to maintain data quality in transition facilities. If data quality changed systematically in transition facilities compared to maintenance facilities, then the DHIS2 findings would be biased.

The relatively short follow-up time of the DHIS2 analysis (15 months following the median transition date in our survey) is a limitation. Some effects of transition may take years to become apparent. The lack of an observed impact on service volume may be due to past investments that continue to pay dividends for service delivery that wane over time. Alternatively, these trends could persist. However, with longer follow-up time, there is greater risk that unobserved, confounding events will bias the analysis.

While the exposure of interest is a permanent transition from PEPFAR support, I cannot directly measure this exposure. Rather, I used two different proxies: transition status as reported by facility in-charges and official PEPFAR transition assignment. Both sources of data are problematic. Many facilities in our survey reporting transition from PEPFAR are officially classified as maintenance, with many being in a 9–12 month gap between IP contracts. Therefore, some facilities reporting transition may receive support again, and transition facilities that knew other sources of support were coming may have responded to support differently than those that were sure they were losing support permanently. Moreover, this resulted in far fewer sites reporting maintenance in our survey than we anticipated, with consequences for statistical power.

There was limited agreement between official transition assignment and self-reported transition assignment by facilities in our survey. Non-differential measurement error in the exposure variable would drive our association to the null. The ITT analysis fails to find negative impacts of transition for most indicators. Yet, repeating the analysis with facility-reported transition status does not change the results dramatically, though this may not have been possible with the sample size.

Lastly, I am using utilization of health services as a metric for health facility functional capacity. This assumes either that supply is the only constraint on service volume or that trends in demand for health services are consistent over time and across transition and maintenance. The former assumption cannot be tested with available data. The latter assumption is violated in for MNCH indicators when considering changes in birthrates in differing areas of Uganda with more or fewer transition sites. In the Karamoja region, in which most PEPFAR facilities have been transitioned, the total fertility rate was 7.9 children per women in 2013–2016 compared to a national average of 5.4. While national fertility rates declined from 6.2 births per woman in the 2008–2011 period, they remained high in Karamoja (116). Therefore, there are differential trends in births across regions, affecting need for MNCH services. Regional differences in demand for MNCH services likely confound some of the associations observed. The same is potentially true for HIV indicators: if transition facilities' catchment areas have more untested and untreated PLHIV, they can potentially increase the number of HTC, new on ART, and current on ART faster, assuming they have the capacity to do so. Regression to the mean might also explain the better performance of transition facilities on HTC and ART indicators. Many transition facilities were selected on the basis of being “low volume” for HIV indicators. However, even if the trends were biased by these factors, the ability to increase testing and enrolling patients on ART would speak against major negative impacts of transition on facility service delivery capacity.

3.5.2 Conclusions

Despite these limitations, this study adds to the literature on the impacts of transitioning GHIs at the facility level. Few studies have examined the impact of withdrawing site-level support on HIV services, and none have done so for as wide a range of HIV and non-HIV services. This study suggests that transition can disrupt services, particularly HIV outreach. However, the findings do not provide evidence that service volume will be negatively affected as a result. There is no evidence to suggest that HIV service delivery will collapse as a result of transition.

Following transition from PEPFAR, affected facilities report discontinuing outreach and perceive negative impacts on access to and quality of services. However, there is little evidence to support negative impacts on patient volume. Further monitoring of the GP will be needed in order to identify possible effects of loss of PEPFAR support on service delivery. Unrelated to transition, the decline in cohort retention on first-line ART is concerning for Uganda’s achievement of the 90-90-90 goal. PEPFAR and the Government of Uganda should undertake efforts to improve retention on ART.

Chapter 4. "PEPFAR Transition in Uganda Impacted Private for-Profit, Private not for-Profit, and Public Facilities Differently"

4.1 Abstract

Since 2003, the President's Emergency Plan for AIDS Relief (PEPFAR) has encouraged private sector provision of HIV care. Private facilities provided a substantial minority of HIV care in Uganda in recent years. However, PEPFAR's Geographic Prioritization (GP) identified 734 facilities for transition, including 137 private not-for-profits (PNFP) and 140 private for-profits (PFPs). It is unclear whether private facilities will receive support from the government to fill gaps left by PEPFAR or maintain HIV services following transition. To assess the effects of GP on private facilities, I use a survey conducted among 145 public, 29 PNFPs, 32 PFPs that report transition from PEPFAR. The survey collected information on prior PEPFAR support, service delivery, commodities, laboratory, staff time-allocation, and human resources. I used multivariate regression models to explore the association between ownership and survey responses, controlling for other characteristics. I also extracted facility-level data from DHIS2 on HIV services for the period October 2013–December 2017. Compared to transitioned public facilities with similar characteristics, PFPs were more likely to discontinue HIV-related outreach (OR=3.03, 1.16–7.82; p=0.025) and to report reduced time on HIV care (OR=6.241, 2.709–14.38, p<0.001) as well as non-HIV care (OR=3.01; 1.32–12.19; p=0.011) since transition. Transitioned PFPs have declines in volume of HIV tests relative to transitioned public facilities (IRR=0.641, 0.471–0.874, p= 0.005) in DHIS2. Private not for-profits were more likely to report declining frequency of supervision (OR = 2.51, 1.456–4.319, p=0.002), loss of permanent staff (OR=5.886, 2.914–11.887, p<0.001), and reduced time spent on HIV care (OR=2.117, 1.054–4.255, p=0.036). However, PNFPs were less likely than public facilities to report

declining quality of HIV care. Although PNFPs continued to provide HIV services, they did so with less staff and support, raising concerns about long-term sustainability. The gap left by PFP facilities in HIV testing may be filled by public facilities, but clients who prefer the anonymity and attentiveness of PFP facilities may be lost in transition.

4.2 Introduction

The private sector has played a large and diverse role in the response to HIV/AIDS in Uganda and many other low-and-middle-income countries (LMICs). That role has been shaped by donor HIV programs, including the President's Emergency Plan for AIDS Relief (PEPFAR). While the inclusion of private providers has been encouraged by some (117), others have warned about the risks of drug resistance from unregulated private providers (118) or raised questions about the sustainability of provision in private facilities following transition (95, 119).

4.2.1 The Private Sector in Uganda

According to the Uganda Private Sector Assessment, the private sector in Uganda is large, and accounts for 47% of the health workforce, including 60% of clinical officers and 80% of doctors (120), though medical doctors in Uganda commonly work in both the private and public sectors (121). According to the 2011/2012 National Health Assessment (NHA), out-of-pocket spending, the majority of which is directed to private providers, accounts for 38% of total health expenditure (120). However, much of this spending is for drugs obtained at pharmacies and drug shops, whereas nearly all HIV commodities (other than condoms) are channeled through health facilities (120).

The facility-based private sector in Uganda encompasses both for-profit facilities as well as faith- and community-based not-for-profit providers, which range in size from single owneroperated clinics to large networks of hospitals and health centers. I restrict this discussion of HIV service provision by private providers to licensed facilities staffed by trained medical personnel who perform clinical HIV services (e.g. HIV testing and counseling – HTC, prevention of mother-to-child transmission – PMTCT, antiretroviral therapy – ART). I thereby exclude traditional healers, quacks, drug shops, and stand-alone pharmacies. This also omits community-based organizations or NGOs that only engage in non-clinical care, such as HIV prevention or psychosocial support.

Private providers in Uganda are divided between a well-organized and somewhat integrated PNFP sector and a weakly-regulated PFP sector. The PNFP sector is predominantly structured along faith-lines. The Uganda Protestant Medical Bureau (UPMB), Uganda Catholic Medical Bureau (UCMB), Uganda Muslim Medical Bureau (UMMB), and the Orthodox Church of Uganda Medical Bureau (OUMB) are the primary umbrella organizations for PNFP providers. These four bureaus supervised 645 PNFP facilities in 2014 (120). PNFPs are distributed across the country, including remote rural areas (120). In addition, PNFPs include NGOs that are not formally connected to a faith-based bureau but provide some stand-alone service delivery. The AIDS Support Organization (TASO) was formed in 1987 as an HIV/AIDS advocacy and palliative care organization and has since become a major provider of community and facility-based care and treatment (122). Mildmay Uganda was founded in 1998 as a privately-funded center of excellence in HIV care and has developed to include a hospital and outpatient clinic (123). PNFPs are integrated into the Government of Uganda's health planning process and receive some financial support from government (124).

By contrast, the private for-profit (PFP) sector in Uganda varies from unlicensed drug shops to large, accredited hospitals, though the latter are few in number (120). Most licensed and clinically-staffed PFP facilities are located in urban areas of Uganda, with Kampala having nearly half the national total in 2005 (125). Many PFPs are directly owned by health professionals, especially medical doctors, the majority of which also work in the public sector (125). PFP providers have their own umbrella organization, the Uganda Private Medical Practitioners' Association (UMPMA), which advocates for its members. However, while the linkage between PNFP's and government is often characterized as "weak", the formal relationship between PFPs and government is nearly non-existent (126).

4.2.2 Private HIV Provision in Uganda

The role of the private sector in provision of health care in LMICs is highly variable, both by country and by type of service (127). In 2008–2010, women in Uganda were more likely to seek care from the private sector for family planning and childhood fever/cough or diarrhea than in any of 12 other LMICs. However, for HIV testing, Ugandan women were more on par with their peers in other LMICs (128). According to Demographic and Health Surveys (DHS) conducted from 2004–2008, the proportion of women receiving their most recent HIV test from a private provider (PFP or PNFP) ranged from 10% in Rwanda to 58% in Haiti, with 28.5% of women and 36.4% of men in Uganda being tested by a private facility (129). A more recent study using the 2011 Uganda DHS puts the share of women tested in the private sector in Uganda at a more modest 18% (128). According to DHIS2 data, 28% of people receiving antiretroviral therapy (ART) in 2015 obtained it from a private provider, almost entirely in PNFPs (120). When accounting for non-clinical HIV services, such as psychosocial support and prevention, the role of the private sector in Uganda was much broader. In 2008–2010, 68.5% of

HIV-related services were delivered by private sector providers (including community-based organizations, NGOs, PFPs, and PNFPs) (130).

While the private sector is diverse and serves many roles, there is an income gradient in the use of private health services in Uganda. While only 18% of all women received an HIV test from a private (PNFP or PFP) provider in 2008–2010, 31% of urban women, and 29% of the richest quintile of women did so (120). As a result, more than half of women receiving a test from a private provider were among the highest wealth quintile in 2008–2010 (128). The relatively affluent demographic using private providers has led some to argue that PNFPs should consider co-payment for ART in the event of funding cutbacks (119), and a pilot model for a fee-based after-hours ART clinic in Kampala has been studied (131). Even in rural areas of Uganda, there is evidence that patients value factors like proximity and quality more than cost in deciding between public and private providers for outpatient care (132), perhaps due to informal payments and travel costs that make public facilities less attractive.

4.2.3 The Role of Donors in Private Sector HIV Service Provision

Donor HIV programs have encouraged the growth of private HIV service provision in many settings, particularly for PNFPs. The private sector's share of total HIV/AIDS expenditure increased following the expansion of donor funding for HIV early in the 2000s. Out of five countries examined by Sulzbach, De, & Wang (2011), PNFP facilities' share of HIV expenditures increased in four (Kenya, Malawi, Rwanda, and Zambia) between 2002/03 and 2005/06 (133). PNFPs' share decreased only in Tanzania, where public provision of HIV/AIDS services prior to 2002 was very limited. The share of expenditures going to PFPs increased in two countries but declined marginally in three countries (133). Coutinho, Roxo, Epino, et al.

(2012) identified Uganda as a leader in private sector involvement in HIV and indigenous NGOs as a major destination for PEPFAR funding in 2007–2010 (122). Coutinho, Roxo, Epino, et al. (2012) also argue that global health programs in Uganda could not have achieved their ambitious targets without the help of indigenous NGOs (122). By 2014, 25% of facilities supported by PEPFAR in Uganda were privately-owned, including 481 PNFPs and 160 PFPs.

4.2.4 Private Facilities in Transition

Private providers, particularly those offering HIV services, often fill niche roles and complement the public sector. However, having multiple, uncoordinated private providers can also fragment the HIV response. As donor funding for HIV declines (1), transitions of HIV programs to national control and funding are likely to increase. Without incentives and political support from donor organizations, it is unclear to what extent private providers will continue to be a part of the HIV response in LMICs.

There is limited research on the private sector in HIV transitions. In South Africa, PEPFAR transition resulted in patients being transferred from private HIV clinics to public primary health centers (30) or, in one pilot, to private general practitioners (134). Interruption in care during private-to-public transfers has been reported in many cases (30, 73), as has reduced satisfaction with the care received in the public clinics (30). None of these studies have examined the effects of loss of support on private providers themselves.

The PEPFAR GP in Uganda presents an opportunity to study the effect that loss of donor support has on private facilities relative to public facilities transitioned from PEPFAR. The GP process identified 734 facilities for transition to "central support" (17), including 137 PNFP and 140 PFPs. Under the GP, these facilities are expected to lose site-level support for supervision, training, and on-site laboratories, outreach, and health worker incentive, but retain above-site support through commodity supply chains and laboratory hubs. It is unclear to what extent private facilities will receive support for HIV services from government to replace lost PEPFAR support or be able to PEPFAR-supported access commodities and laboratory hubs.

4.2.5 Objectives

This paper is one of a series examining the impact of the PEPFAR GP on 1) health systems and human resources for health, 2) health services, and 3) effects on private and public providers. Other papers have noted the negative impacts of transition reported by health facilities on access to care and the health workforce but did not identify negative impacts of transition on staffing or the volume of HIV and non-HIV services delivered.

The objective of this paper is to understand how the experiences and responses of private facilities transitioned from PEPFAR, both PNFPs and PFPs, support differ from those of transitioned public facilities. Compared to public facilities, I anticipate that transitioned PNFPs will be more likely to lose supervision, access to training, and access to lab networks. However, PNFPs, which have a strong mandate to provide care and greater flexibility than public facilities in how they do so, will continue to offer HIV services at a level comparable to public facilities. I also expect PFPs to lose more support than transitioned public facilities. However, PFPs do not have the same obligations or motivations as PNFPs, and I expect PFPs to disengage from HIV services, which mostly consists of HIV testing, following transition. To isolate the effect of facility ownership on the selected outcomes, I will control for factors likely to differ across ownership types, including level, size of HIV workforce, time since transition, and amount of support lost during transition.

4.3 Methods

A team from Johns Hopkins Bloomberg School of Public Health and Makerere University School of Public Health conducted a mixed methods evaluation of the GP in Uganda using document review, key informant interviews, a facility survey, secondary data analysis, and longitudinal case studies. To address the objectives of this article, I relied on the facility survey and analysis of secondary data from DHIS2 components (Table 30). I divide the outcomes into two categories: support provided to health facilities and responses of facilities to transition. The former includes HIV supervision from any source, continued supervision by the IP, lab testing disruptions, and training. The latter includes service delivery volume (from DHIS2) and information on provision of HIV outreach, worker time allocation for HIV & non-HIV clinical care, and termination of staff since transition (from the facility survey).

Table 30: Objectives and Methods

Objectives	Outcomes	Data Source
Support provided to health facilities	HIV Supervision Frequency IP Supervision Viral Load Testing Disruption Sputum Testing Disruption Training-Days per Worker	Facility Survey
Facility and worker responses to transition	Discontinuation of Outreach Time-allocation (in-charge reported) Time-allocation (worker reported) Self-Reported Quality of HIV Services Loss of Staff Since Transition	Facility Survey
	HIV Testing & Counseling Current on ART 12-month Cohort Retention on First-line ART	DHIS2

ART, antiretroviral therapy; DHIS2, district health information system 2.0; HIV, human immunodeficiency virus.

4.3.1 Data Source: Facility Survey

In Uganda, the study team conducted a cross-sectional facility survey in July & August of 2017, about nine months after the median transition date and four months after the official end of transition reported by USAID. For logistical reasons, we limited the sampling area for this survey to 42 districts: 40 districts in Northern and Eastern Uganda, as well as Kampala and Wakiso districts in Central Uganda. Kampala and Wakiso are urban districts and have more than half of Uganda's PEPFAR's transitioning PFPs.

I constructed the sample frame from a list supplied by USAID with designation of facilities as intended for either maintenance, scale-up, or transition to central support. Only facilities supported by USAID-contracted IPs were included. I also excluded all facilities identified for scale-up. From the sample frame, I selected districts using a stratified random sampling design with three strata: 1) 100% selection of all districts containing transitioning health center IVs and/or Hospitals as well as Kampala and Wakiso, 2) Random sampling of 11 out of 18 remaining districts that were designated as central support or maintenance districts, and 3) Random sampling of 6 out of 14 priority districts. I sampled all facilities within selected districts that were identified as maintenance or transition, except for Kampala/Wakiso, where I selected a 40% sample of transition facilities only.

Using this process, I selected 275 facilities. I assumed a 10% non-response rate to achieve a final sample of approximately 250. Two facilities that were selected for longitudinal case studies by the parent study but not randomly selected for the facility survey — Amuru HC III (PNFP) and JB Clinic (PFP) — were purposively added to the survey sample for a total of 277. Enumerators were able complete surveys at 262 facilities. Of the 15 facilities that could not be surveyed, nine had closed permanently, two were closed for construction, two facilities were identified as duplicate records, one (a PFP facility) refused to participate in the survey, and one was not accessible due to road conditions. An additional 36 claimed to have had no PEPFAR support within the past 3 years, 206 reported having been transitioned, and 20 reported continuing to receive PEPFAR support. This was contrary to what was expected, due both to the 36 sites with no recent PEPFAR support and the larger than expected proportion of sites reporting transition. From follow-up interviews with IPs and USAID, we determined that as many as 60 of the transitioned facilities were experiencing a break in support between IPs lasting for 9–12 months. However, as these facilities reported similar processes and impacts as those that were intended for transition, I have included them as transition facilities in this analysis. I excluded the 36 facilities that reported no support from PEPFAR IPs. To examine differences between transitioned PFPs, PNFPs, and public facilities, I restrict the analysis in this paper to facilities reporting transition only.

In smaller facilities, survey interviews were conducted with facility in-charges, or their acting replacements. In larger facilities, multiple respondents (e.g., facility in-charge, head of the HIV clinic, head of the maternity ward, pharmacist, laboratory director, and a financial officer) contributed to different components of the survey. In addition, enumerators sought 2–3 staff that provide HIV care (including potentially the primary respondent) present on the day of the survey to answer a short individual questionnaire. The questionnaire was related to trends in the worker's own time-allocation, receipt of incentives, job satisfaction, and motivation on a ten-item index developed by Mbindyo et al. (2009) (100). These individual interviews were conducted in private to improve confidentiality. A total of 429 individual interviews were collected from transition facilities (304 in public, 71 in PNFPs, and 54 in PFPs).

Transition Impact Index

The purpose of this paper is to isolate differences in outcomes that are due to ownership by controlling for other potential confounders. Public, PFP, and PNFP facilities had varying levels of PEPFAR support at baseline. To control for the quantity of support that facilities lost during transition, I constructed a transition impact index for data reduction purposes. Site level PEPFAR support comes in many forms. PEPFAR IPs provide supportive supervision; conduct on-site trainings and facilitated access to off-site trainings; support laboratory and outreach capacity related to HIV; and provide workers with salaries and incentives (top-ups, bonuses, outreach allowances, and mobile phone airtime).

Rather than including many different types of support lost in transition, which would overwhelm the small sample size, I used exploratory factor analysis to construct a single index. In constructing the transition impact index, I included four ordinal variables. For non-salary support, I sum the types of incentives provided by the IP to at least one worker in the facility prior to transition (0=none provided, 1=bonuses or outreach allowances provided, 2=both provided). As nearly all this support was lost during transition, it is a proxy for transition impact. The other three components of the index are the number of types of IP support for HIV reported lost (for training, supervision, outreach, ART, Laboratory), number of HIV services (HTC, PMTCT, ART, Outreach) for which the in-charge identified the PEPFAR IP as primary source of support prior to transition but not after transition, and the change in frequency of HIV supervision since transition (-1 decreased, 0 same, 1 increased). I attempted to include loss of salaries paid by the IP, both as a proportion of workers and as a binary variable for any salaries lost; however, salaries had a high degree of uniqueness and added little to the index. Principle component analysis with a polychoric correlation matrix resulted in a single factor model that explained 50.7% of variance. I used exploratory factor analysis to determine factor loadings and created an index score for each facility (Table 31).

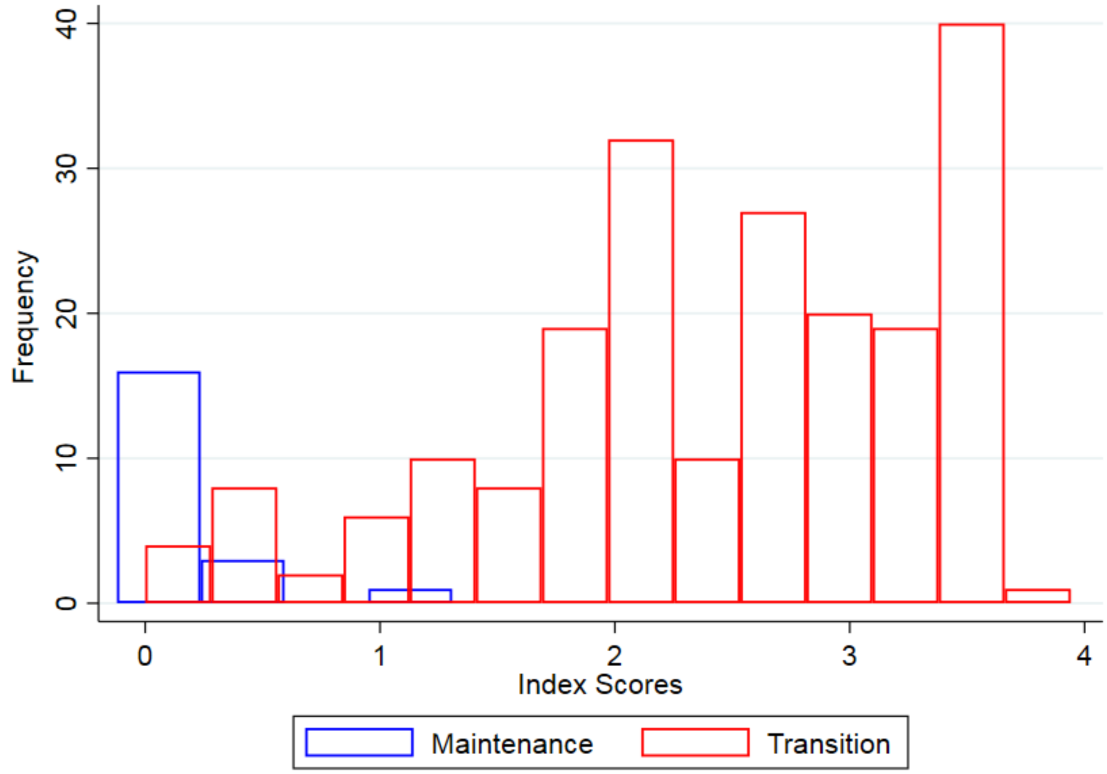
Table 31: Transition Impact Index

Category	Definition	Type	Comment	Factor Loading
Non-Salary Support for HIV prior to transition: Bonuses/Top-Ups & Outreach	Coded as "0" if staff report neither was provided, "1" if workers report one of bonuses/top-ups or outreach allowances, and "2" if staff report receiving both before transition. Nearly all such support was lost during transition.	Ordinal (0,1,2)	Included	0.123
Types of Support Lost in the Transition	Number of types of HIV support (Training, supervision, Outreach, ART, Laboratory) facilities report losing due to transition	Ordinal (0-4)	Included	0.424
PEPFAR Support to HIV Services	Number of HIV services (HTC, PMTCT, ART, Outreach) for which PEPFAR IP was identified as primary source before transition and not after transition	Ordinal (0-4)	Included	0.395
Change in HIV Supervision Frequency	-1 if frequency declines, 0 if frequency remained the same (or if no supervision reported for HIV), 1 if frequency increased	Ordinal (-1,0,1)	Included	-0.121
Salaries paid by PEPFAR IP	Change in proportion of workers providing HIV services whose salaries are paid by PEPFAR	Continuous	Salary support was rare. Replaced with a binary measure.	N/A
	"1" if facility lost any salary support for HIV workers	Binary	Ultimately dropped from the index	N/A

ART, antiretroviral therapy; DHIS2, district health information system 2.0; HIV, human immunodeficiency virus; HTC, HIV testing and counseling; IP, implementing partner; PEPFAR, President's Emergency Plan for AIDS Relief; PMTCT, prevention of mother-to-child transmission.

The index predicts transition status with a high degree of accuracy (Area under the ROC Curve 0.981), but the diversity of scores for transition facilities is considerable (Figure 22). The range of index scores suggests that the amount of support lost in transition differed considerably across transition facilities. The impact index was independently associated with several outcomes: discontinuation of outreach, loss of staff, and in-charge's perception of worsening HIV access and quality of HIV care. However, the index is only a rough measure of the loss of support during transition. Since the index contains information on supervision frequency, I omit it from the analysis of supervision frequency.

Figure 22: Transition Impact Index Scores by Transition Status



Transition Preparedness Index and Other Covariates

In addition to the transition impact index, I included other covariates. The covariates included are facility level (health center - HC II or clinic, HC III, HC IV, or hospital), number of HIV workers prior to transition, number of months since transition, an index of preparedness, and district-level dummies (central support district and whether the district was created since 2007). I created the preparedness index by taking an unweighted average of 14 questions about the facility's preparedness for transition in domains of communication (to facility, to patients, between facilities), consistency (of HIV and MNCH services, reporting systems, and outreach to key populations) before and after transition, and capacity (of facility, management, staff) for transition, each rated on a 5-item Likert scale (1=strongly disagree, …, 5=strongly agree), excluding don't know/not applicable. Through these controls, I estimated the effect of ownership on outcomes — independent of the facility's level, HIV workforce size, preparedness for transition, district status, time since transition, and amount of PEPFAR support lost.

4.3.2 Facility Survey Analysis

The outcomes were selected for this analysis after the survey had already been conducted but prior to the analysis (i.e. "pre-specified"). The outcomes were chosen based on hypotheses about what types of health system components were likely to be differentially affected in private and public facilities. I expected that transition would result in more of a decline in supervision in PFPs and PNFPs than in public facilities, under the assumption that district governments would prioritize their own facilities. However, PEPFAR IPs, which provide direct service delivery at PNFPs, may preferentially continue to supervise PNFPs after transition.

Access to trainings following transition may be affected differently in private facilities, which have fungible resources from patient fees that can be used for transport, but private facilities may also be marginalized in accessing trainings hosted by the MoH. Sputum and viral load testing were disrupted more in transition than in maintenance, and I hypothesized that private facilities would be more marginal to the lab systems, and therefore more likely to report disruptions. Given that few PFPs perform VL testing, I restricted the comparison to PNFPs vs. public facilities.

Due to the large number of potential comparisons, I pre-specified 17 hypotheses to reduce the risk of multiple comparison problems (Table 32). Rather than applying Bonferroni correction (i.e. dividing the alpha level by the number of comparisons), which would be overly conservative given correlation between outcomes, I have chosen to report the expected number of false positives for each level of significance under the conservative assumption that all outcomes are independent. The expected number of false positive findings at the 0.01─0.05 level is 0.68 and 0.17 at the 0.01 level, making it possible that I will have roughly one spurious finding at the 0.1–0.05 level and unlikely (equal or less than a 1-in-6 chance) at the 0.01 level. I included post-hoc findings not pre-specified only if they are significant at the 0.01 level.

I used logistic regression models to analyze the facility survey data for all but one variable, the number of HIV Training-days per HIV worker since transition (Table 32). I estimated the number of HIV training-days by adding up the product of training length and number of attendees (total worker-days) and then dividing by the number of HIV workers and the length of time since transition (units: days/worker/year). The estimate of annualized number of training-days per HIV worker per year is noisy and highly non-normal. Therefore, I used the non-parametric permutation test with 10,000 replicates to determine statistical significance of the difference between training in PNFP and public. By permuting the ownership status of PNFPs vs. public randomly, the permutation test generates a null distribution to which the observed difference can be compared. As the sample is small and there are extreme outliers, I also used non-parametric bootstrap resampling with 10,000 replications to test for robustness to exclusion of some outlier values.

All analyses from the facility survey used weights, stratification, and clustering to account for survey design. For outcomes collected from a sample of HIV workers within facilities (e.g. time-allocation), I accounted for clustering at the facility level as well as clustering due to survey sampling. All analyses were conducted using Stata 15 (99).

Table 32: Hypotheses and Comparisons

Pre-Specified Hypothesis Tests:	Comparisons	Number of Tests	Outcome Type
IP providing supervision after transition	PNFP vs. Public; PFP vs. Public	2	Binary (Y/N)
Change in HIV Supervision Frequency (less frequent vs. same/more frequent)	PNFP vs. Public; PFP vs. Public	2	
In-charge Reports Less Time on HIV and More Time on MNCH	PNFP vs. Public; PFP vs. Public	2	
Facility stopped providing outreach after transition	PNFP vs. Public; PFP vs. Public	2	
Change in Worker Time Spent on HIV Clinical Care	PNFP vs. Public; PFP vs. Public	2	
Change in Time Spent on Non-HIV Clinical Care	PNFP vs. Public; PFP vs. Public	2	
Change in Frequency of Disruption of Viral Load Testing	PNFP vs. Public	1	
Change in Frequency of Disruption of Sputum Testing	PNFP vs. Public; PFP vs. Public	2	
Training Days HIV per Worker per Year Since Transition	PNFP vs. Public; PFP vs. Public	2	Continuous
Post-hoc Findings:	**Comparisons**		**Outcome Type**
In-Charge Reports Loss of Staff[1] As A Result Of Transition	PNFP vs. Public	1	Binary (Y/N)
HIV Quality Change (Worse vs. Same/Better)	PNFP vs. Public	1	Binary (Y/N)

[1] Question: "Loss of staff through their resignation, or reassignment to other health facilities". Response: "The effect has already occurred" vs ("The effect has not yet occurred but you expect it to do so" OR "You don't expect this effect to occur" OR "You don't know whether the effect is likely to occur or not")

Footnote: HIV: human immunodeficiency virus; MNCH: maternal, neonatal, and child health; PNFP, private not for-profit; PFP, private for-profit.

4.3.3 DHIS2 Data

I extracted data from the Ugandan District Health Information System 2.0 (DHIS2) for all facilities in Uganda that PEPFAR claimed to support in FY2014. Extracted variables include the number of HIV tests and counseling (HTC), number of patients current on ART, and the proportion of ART cohort retained on first-line treatment at 12 months (cohort retention). I used DHIS2 data to identify the ownership of facilities. I did not limit the DHIS2 data to the facility survey sample in the interest retaining sample size. Therefore, I am unable to include survey data as covariates in the analysis of DHIS2 data. Our data on transition status comes from PEPFAR records. As mentioned previously in this thesis, this information is in poor agreement with reporting by the facilities themselves. I considered a facility as having enough data if there are ≥2 reports from Oct 2013–June 2016 and ≥2 reports from July 2016–Dec 2017. Reporting to DHIS2 is incomplete, especially for private facilities. Given that few PFPs report providing ART, I have not included them in the analysis of ART indicators.

4.3.4 DHIS2 Analysis

DHIS2 does not distinguish between missing and zero. Therefore, missing values may be due to no services having been provided or due to counts not being entered. For facilities that submitted a report to DHIS2 but have empty fields for HTC and current on ART, I imputed zero for the reporting period. However, I did not impute any values for cohort retention, which should not be 0. To clean the data for HTC and current on ART, I flagged outliers that are substantially above the mean value for the facility. I excluded any months when the number of HTC reported exceeds the facility average by a factor of 20 when the average is greater than 10. I also excluded values for HTC of more than 10,000 per month, which exceeds the level of even the largest facilities. I excluded any quarters for which current on ART is >5x the facility mean value, provided that the mean number of patients current on ART is greater than 5. Only 0.06% of public and PNFP facility and 0.25% of PFP facility records were flagged for HTC and no records were flagged for ART. Due to changes in reporting for cohort retention in 2015, there were many illogical values (<1%, >100%) for cohort retention that I flagged and excluded (11% of total). The annex describes the cleaning process in more depth.

I create time trend curves of the mean number of HTC, current on ART, and cohort retention. I used random intercept Gaussian and negative binomial regression models, which are robust to missing under the missing at random assumption (MAR). MAR requires that item-level missing is not associated with the true value. The random intercept models also account for the autocorrelation present in the longitudinal data by inducing an exchangeable (constant covariance) correlation structure. As an exchangeable model may be incorrect, I used a Huber-White sandwich estimator to create robust confidence intervals and check these results using bootstrap estimation using 500 replications for each analysis.

I used difference-in-difference (hereafter D-in-D) as the measure of association for HTC and cohort retention. D-in-D analysis relies on the parallel baseline trends assumption. This assumption cannot be confirmed, but visual inspection of trend curves helps. For current on ART, which shows substantial differences in baseline trends, I compared the change in slope for transition facilities to that for maintenance facilities (hereafter "trend analysis") around October 2016, the median transition date for public and PNFPs in our facility survey. This accounts for differing baseline trends and makes the change in slope (not level) the measure of transition's impact.

Both D-in-D and Trend analysis account for secular changes by using transitioned public facilities as a control. For D-in-D models, I used Oct 2013–Dec 2014 for a pre-transition period and Jan–Dec 2017 for post-transition. Public and PNFP facilities in our facility survey sample have similar transition timelines (Table 33). However, for PFPs, the median transition date was April 2015, more than a year before the median for public facilities. The preferred transition window (Jan 2015–March 2017) contains most PFP and nearly all public facility transitions in our facility survey sample. In sensitivity analyses I varied the transition period for PFPs. I also excluded the period Oct 2013–January 2014, which had very high volume of HTC in PFPs.

In order to interpret estimates from D-in-D and trend analysis models as estimates of the causal effect of transition, I must make two further assumptions: 1) that exposure is unrelated to trends in the indicator and 2) no spill-over between units. Unlike in previous papers where the exposure was transition, the exposure here is facility ownership. However, ownership is correlated with selection of facilities for transition, as nearly all PFPs were transitioned on the basis of being "low volume" while this was the case for only some public facilities and PNFPs. Therefore, transition PFPs may have different trends in HTC related not to transition but to regression to the mean. The second assumption requires that patients do not switch systematically between transitioned PFPs, PNFPs, and public facilities. It could be argued that patients would prefer to transfer to facilities that continue to receive PEPFAR support, where the option is available, but movement between transitioned facilities of differing ownership status is also possible. Given the potential violation of these assumptions, the estimates from the models should not be viewed as causal effects modification by ownership.

4.4 Results

4.4.1 Description of data

In the survey, 206 facilities reported have been transitioned from PEPFAR (Table 33: Facility Survey Descriptive Statistics). The majority were public (N=145, 70%). Private facilities were roughly equally split among PNFPs (N=29, 14%) and PFPs (N=32, 16%). Most facilities (65%) were health center IIIs (HC IIIs). Only 11% of facilities were HC IV or hospitals, but 74% of all facilities surveyed offered ART. Notably, among PFPs, only 9% offered ART and the majority of PFPs were low-level facilities (HC II or Clinics). The mean transition impact index score was highest for public facilities (2.58), followed by PNFPs (2.25), and lowest for PFPs (1.88). Preparedness scores were significantly higher for PNFPs (3.73) than for PFPs (3.25) and public facilities (3.35).

Table 33: Facility Survey Descriptive Statistics (Unweighted Proportions)

PEPFAR Transition Facilities	**Public**	**PNFP**	**PFP**
	N (%)	**N (%)**	**N (%)**
Total	145 (70%)	29 (14%)	32 (16%)
Level			
HC II or Clinic	22 (44%)	6 (12%)	22 (44%)
HC III	104 (78%)	20 (15%)	9 (7%)
HC IV	12 (86%)	1 (7%)	1 (7%)
Hospital	7 (78%)	2 (22%)	0 (0%)
Region			
Eastern	101 (81%)	15 (12%)	8 (6%)
Northern	42 (75%)	12 (21%)	2 (4%)
Central (Kampala/Wakiso)	2 (8%)	2 (8%)	22 (85%)
Services Offered (as % of facilities in ownership type)	**N (%)**	**N (%)**	**N (%)**
HTC	137 (95%)	27 (93%)	32 (100%)
HIV Outreach	58 (40%)	16 (55%)	11 (34%)
PMTCT	134 (92%)	26 (90%)	13 (41%)
ART	127 (88%)	22 (76%)	3 (9%)
Reports HMIS 105	145 (100%)	27 (93%)	23 (72%)
Reports HMIS 106a	113 (84%)	14 (54%)	1 (8%)
Mean Transition Impact Index Score (95% C.I.)	2.58 (2.42–2.74)	2.25 (2.04–2.46)	1.88 (1.63–2.12)
Transition Preparedness Index (95% C.I.)	3.35 (3.26–3.45)	3.73 (3.45–4.01)	3.25 (3.08–3.41)
Transition Date Distribution			
10^{th} Percentile	May 2015	March 2015	February 2014
Median	September 2016	September 2016	April 2015
90^{th} Percentile	March 2017	March 2017	September 2016

Footnote: ART, antiretroviral therapy; C.I.: confidence interval; HTC: HIV testing & counseling; PEPFAR, President's Emergency Plan for AIDS Relief; PMTCT, prevention of mother-to-child transmission; PNFP, private not for-profit; PFP, private for-profit.

In Table 34, I present descriptive statistics for the DHIS2 data. Out of 734 facilities designated by PEPFAR for transition, 457 are listed as public, 137 as PNFPs, and 140 as PFPs. The proportion of facilities with enough data for analysis for HMIS 105 was 86.7% of public, 85.4% for PNFPs, but only 43.6% for PFPs. There were 106 public and 21 PNFP facilities that reported data on ART through HMIS 106a.

Table 34: DHIS2 Descriptive Statistics (Unweighted Proportions)

	Public	PNFP	PFP
	N (%)	N (%)	N (%)
Number of PEPFAR facilities Intended for Transition	457	137	140
Reporting for HMIS 105 (% Total)	396 (86.7%)	117 (85.4%)	61 (43.6%)
Reporting for ART Indicators	106	21	3
Mean Number Current on ART	146.8	85.9	*Omitted*
Mean number of HTC Per Month	217.5	210.5	99.6
N data flagged for HTC (%)	10 (0.06%)	3 (0.06%)	6 (0.25%)
N data flagged for Current on ART (%)	0 (0.0%)	0 (0.0%)	*Omitted*
N (%) data flagged for Cohort Retention	44 (10.0%)	10 (12.7%)	*Omitted*

Footnote: ART, antiretroviral therapy; C.I.: confidence interval; CS, central support; HTC: HIV testing & counseling; PEPFAR, President's Emergency Plan for AIDS Relief; PMTCT, prevention of mother-to-child transmission; PNFP, private not for-profit; PFP, private for-profit.

4.4.2 Facility Survey: Effects on Health Service Inputs

A previously noted in the first (Human Resources for Health) paper in this thesis, transition facilities as a whole report a reduction in supervision frequency for HIV, a reported decline in quality of HIV care, loss of staff, discontinuation of outreach, and less worker time spent on HIV clinical care, but no significant differences for non-HIV clinical care or in training days per worker per year since transition.

In the Annex, I present the weighted, unadjusted proportions of public, PNFP, and PFP transition facilities reporting pre-specified and post hoc survey outcomes (Table 54). Using unadjusted proportions, PNFPs were significantly more likely than public facilities to report a decline in HIV supervision frequency (61.5% vs. 43.9%, p=0.026). PNFPs were less likely than public to report increased disruption of VL testing (8.8% vs. 24.3%, p=0.016). PFPs were less likely to report declining supervision frequency (18.0% vs. 43.9%, p=0.002).

Table 35 presents the results for the multivariate analysis of changes in support during transition. Compared to public transition facilities, PNFPs are more likely to report declining frequency of HIV supervision from any source (OR=2.507, 1.456─4.319, p=0.002). Larger facilities also reported declines in HIV supervision frequency more often than smaller facilities. Both PFPs and PNFPs were less likely than public facilities to report increased (vs. same/decreased) disruption of sputum testing (Table 35).

Table 35: Facility Survey Multivariate Regression Models (Changes in Support)

Hypothesis Type	***Pre-Specified***	**Pre-Specified**
Model	***Logistic***	**Logistic**
Outcome	**Decline in HIV Supervision Frequency**	**Increased Disruption of Sputum Testing**
	OR (95% C.I.) p-value	***OR (95% C.I.) p-value***
Ownership:		
PNFP vs. Government	**2.507** (1.456, 4.319) 0.002**	**0.242* (0.065, 0.900) 0.035**
PFP vs. Government	0.577 (0.268, 1.242) 0.152	**0.171** (0.052, 0.558) 0.005**
Level:		
HC III vs. HC II	1.533 (0.948, 2.478) 0.079	
IV/Hospital vs. HC II	**4.027** (1.767, 9.177) 0.002**	
IV/Hospital vs. HC II/HC III		1.859 (0.576, 5.998) 0.284
Transition Impact Index	**Excluded[1]**	**0.506*** (0.365, 0.702) <0.001**
Preparedness Index	0.765 (0.544, 1.076) 0.118	0.982 (0.710, 1.358) 0.907
Months since Transition	**1.029* (1.006, 1.054) 0.017**	1.011 (0.985, 1.038) 0.373
Number of HIV Workers Prior to Transition	1.064 (0.998, 1.135) 0.057	0.998 (0.943, 1.057) 0.944
Central Support District	1.124 (0.802, 1.576) 0.481	0.659 (0.341, 1.275) 0.203
New District	0.820 (0.605, 1.110) 0.188	1.048 (0.438, 2.512) 0.911
Constant	1.266 (0.276, 5.800) 0.752	1.791 (0.114,28.02) 0.911
N	204	**160**

*Notes: *p<0.05, **p<0.01, ***p<0.001. [1]The transition impact index uses information about supervision frequency, making it tautologically associated with the outcome "Change in Frequency of HIV Supervision". I omitted the index from the analysis.*

Footnote: HIV, human immunodeficiency virus; HC, health centre.

4.4.3 Facility Survey: Effects on Health Service Delivery

In the unadjusted analysis, PFP workers were more likely to report spending less time on HIV care than public facility workers (59.6% vs. 23.5%, p<0.001) but the difference was not significant for PNFPs (Table 54). One post-hoc finding, in-charge reports declining quality of HIV services, is significantly less commonly reported in PNFPs vs. public transition facilities (41.6% vs. 21.4%, p<0.001).

Adjusting for facility characteristics, transitioned PNFPs are more likely to report loss of staff (OR = 5.886, 2.914–11.887, p<0.001) (post-hoc) and reduced time spent on HIV care among remaining staff (OR=2.117, 1.054–4.255, p=0.036) compared to public. However, PNFP facilities are less likely to report a perceived decline in quality of HIV services (OR=0.491, 0.301–1.395, p=0.006) than public (post-hoc).

PFPs are more likely to discontinue outreach (OR=3.029, 1.325–6.925, p=0.011) and their workers are more likely to report declining time (vs. increased or same time) spent on HIV care since transition (OR=6.241, 2.709–14.38, p<0.001) as well as decreased time on non-HIV care (OR=3.012, 1.161–7.817, p=0.025).

Table 36: Facility Survey Multivariate Regression Models (Facility & Worker Responses)

Hypothesis Type	***Pre-Specified***	***Pre-Specified***	***Pre-Specified***	***Post hoc***	***Post Hoc***
Model	***Logistic***	***Logistic***	***Logistic***	***Logistic***	***Logistic***
Outcome	**Discontinue Outreach**	**Workers Report Less Time on HIV Clinical Care**	**Workers Report Less Time on Non-HIV Clinical Care**	**Perceived HIV Quality Change**	**In-charges Report Loss of Staff**
	OR (95% C.I.) p-value	***OR (95% C.I.) p-value***	***OR (95% C.I.) p-value***	***OR (95% C.I.) p-value***	***OR (95% C.I.) p-value***
Ownership:					
PNFP vs. Government	1.087 (0.518,2.281) 0.819	**2.117* (1.054,4.255) 0.036**	1.429 (0.665,3.069) 0.344	**0.491** (0.301,0.800) 0.006**	**5.886*** (2.914,11.89) <0.001**
PFP vs. Government	**3.029* (1.325,6.925) 0.011**	**6.241*** (2.709,14.38) <0.001**	**3.012* (1.161,7.817) 0.025**	0.636 (0.290,1.395) 0.246	2.274 (0.831,6.225) 0.105
Level:					
HC III vs. HC II	1.016 (0.525,1.966) 0.960	1.161 (0.578,2.332) 0.663	0.569 (0.266,1.216) 0.138	**0.419* (0.217,0.808) 0.012**	1.935 (0.806,4.649) 0.133
IV/Hospital vs. HC II	1.361 (0.568,3.260) 0.473	0.917 (0.345,2.438) 0.856	1.165 (0.402,3.372) 0.769	1.335 (0.477,3.739) 0.567	1.585 (0.532,4.723) 0.392
Transition Impact Index	**2.480*** (1.821,3.376) <0.001**	**1.731** (1.247,2.404) 0.002**	0.994 (0.703,1.406) 0.974	**1.757*** (1.360,2.271) <0.001**	**1.477* (1.042,2.092) 0.030**
Preparedness Index	1.285 (0.838,1.970) 0.237	0.699 (0.463,1.055) 0.085	1.000 (0.665,1.501) 0.998	**0.422*** (0.266,0.667) <0.001**	0.582 (0.326,1.039) 0.066
Months since Transition	**1.026* (1.002,1.050) 0.032**	1.000 (0.973,1.026) 0.975	1.028 (0.988,1.071) 0.166	1.021 (0.993,1.050) 0.131	**0.948** (0.919,0.978) 0.002**
Number of HIV Workers Prior to Transition	0.929 (0.850,1.014) 0.095	0.976 (0.889,1.072) 0.602	**1.126* (1.009,1.258) 0.036**	**0.895* (0.818,0.979) 0.018**	1.075 (0.982,1.177) 0.113
Central Support District	0.820 (0.424,1.585) 0.540	**0.381** (0.204,0.714) 0.004**	0.859 (0.377,1.955) 0.705	1.056 (0.640,1.744) 0.823	**1.796* (1.160,2.782) 0.011**
New District	1.108 (0.489,2.512) 0.797	1.787 (0.839,3.802) 0.126	2.519 (0.921,6.892) 0.070	0.658 (0.385,1.126) 0.121	1.482 (0.944,2.327) 0.085
Constant	**0.084* (0.010,0.681) 0.022**	0.287 (0.055,1.491) 0.131	**0.113* (0.02,0.648) 0.017**	**13.13** (2.7,72.88) 0.005**	**0.048** (0.006,0.409) 0.008**
N	179	427	426	204	175

*Notes: *p<0.05, **p<0.01, ***p<0.001.*

Footnote: HIV, human immunodeficiency virus; HC, health centre.

Other outcomes were not statistically significant, and I report these in the Annex (Table 55). Notable among the null findings are that neither PFP nor PNFP in-charges report spending “less time on HIV and more time on MNCH”, relative to public facilities.

Though PNFPs report 2.76 more days of HIV training per worker since transition than public facilities, the significance of the difference cannot be assessed using Gaussian standard errors given the highly skewed distributions of annualized HIV training days per worker since transition (Figure 23). Most PNFPs and public facilities have had no trainings since transition, making median zero for both. The difference in means is primarily due to the few outliers reporting 30 or more days of HIV-related training.

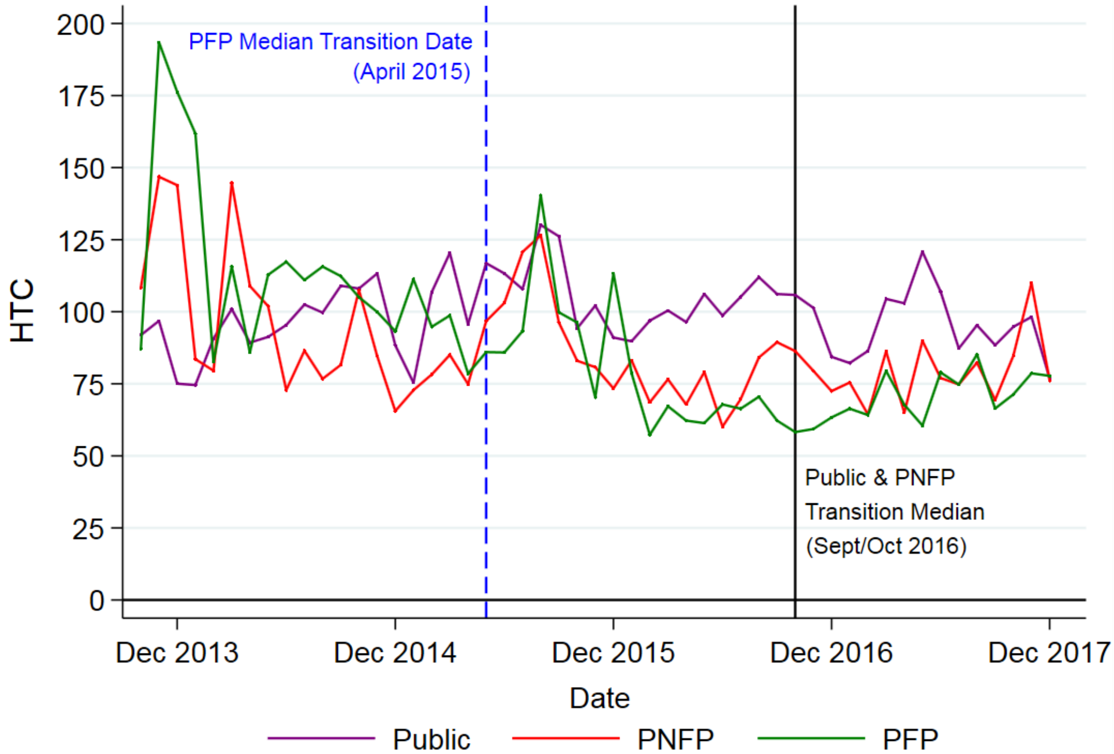
In order to assess the significance of the difference in training for PNFPs and public facilities, I permute membership in PNFP and Public facilities 10,000 times to yield a null distribution under which the ownership is randomly assigned. Only in 211 out of 10,000 repetitions (p=0.021) did the adjusted difference between PNFPs and public facilities from the null distribution exceed the observed value. This would suggest that PNFPs workers have had significantly more training since transition than their public peers. However, the outlier values were likely influential. Therefore, I also used bootstrap resampling as means of testing the robustness to outliers, and the difference is not significant: 2.762 days (-1.361, 6.885; p=0.189). Furthermore, excluding the top three values with >30 days of reported training per year, the difference between PNFPs and public shrinks to just 0.33 days.

Figure 23: Histogram of Annualized HIV Training Days per Worker since Transition

4.4.4 DHIS2: Impacts on HIV Service Volume

I present trend curves for the mean number of HTC, current on ART, and 12-month cohort retention at PEPFAR facilities from Oct 2013–December 2017 in Figures 24–28. Figure 24 suggests that HTC has been declining in PFPs and PNFPs relative to public facilities.

Figure 24: Trends in HTC in Public, PNFP, and PFP Facilities



Examining the HTC model output, there is a significant D-in-D for PFPs, but not for PNFPs for HTC (Table 37). The relative difference-in-difference for PFPs is about -38% (IRR=0.621, 0.426–0.903, p=0.005) fewer tests using robust confidence intervals. The bootstrap confidence intervals are similar and do not change the conclusions. Varying the transition windows for PFPs (Annex: Table 56) and PNFPs (Annex: Table 57) also does not affect the results qualitatively. The trends in HTC for PFPs and public in Oct 2013–Jan 2014 are clearly not parallel. Excluding these four months, the baseline trends appear to be parallel, and the decline in PFPs smaller but is still significant at

-32.1% (Annex: Table 56).

Table 37: DHIS2 D-in-D Regression Models for HTC

	HTC (Robust S.E.)		**HTC (Bootstrap S.E.)**	
	PNFP vs. Public	**PFP vs. Public**	**PNFP vs. Public**	**PFP vs. Public**
	IRR (95% C.I.)	**IRR (95% C.I.)**	**IRR (95% C.I.)**	**IRR (95% C.I.)**
Ownership				
PFP vs. Government		**2.817*** (1.702, 4.664) <0.001**		**2.821*** (2.485, 3.203) <0.001**
PNFP vs. Government	**1.707** (1.164, 2.505) 0.006**		**1.709*** (1.511, 1.932) <0.001**	
Post	1.145 (0.970, 1.351) 0.110	1.145 (0.970, 1.353) 0.111	**1.145** (1.052, 1.245) 0.002**	**1.145** (1.052, 1.247) 0.002**
Ownership x Post Transition				
PFP x Post Transition		**0.621* (0.426, 0.903) 0.013**		**0.621*** (0.520, 0.741) <0.001**
PNFP x Post Transition	1.100 (0.816, 1.484) 0.532		1.100 (0.947, 1.278) 0.213	
Level:				
HC IV & Hospital (vs. HC II & III)	**13.01*** (7.270, 23.29) <0.001**	**6.807** (2.113, 21.93) 0.001**	**13.02*** (11.72, 14.46) <0.001**	**6.811*** (6.030, 7.693) <0.001**
Constant	**20.14*** (15.61, 26.00) <0.001**	**20.50*** (15.81, 26.59) <0.001**	**20.12*** (18.61, 21.75) <0.001**	**20.47*** (18.85, 22.23) <0.001**
N obs.:	**11,902**	**10,319**	**11,902**	**10,319**
N facilities:	**513**	**454**	**513**	**454**
Public	396	396	396	396
PNFP	117		117	
PFP		58		58

*Notes: *p<0.05, **p<0.01, ***p<0.001.*

Footnote: HC: health centre; HTC: HIV testing and counseling; IRR: incidence rate ratio; PNFP, private not for-profit; PFP, private for-profit.

Figure 25 suggests that PNFPs have not increased their level of current on ART as much as public transition facilities. However, disaggregating facilities by size (HC II & HC III vs. HC IV & Hospital) the picture becomes clearer. In Figure 26, HC II & III PNFPs have not had a clear drop-off in their trends in current on ART; however, trends in current on ART are clearly diverging by ownership for transition HC IV and Hospitals by ownership (Figure 27). There are only 3 PNFPs and 13 public facilities at the level of HC IV or Hospital that were transitioned from PEPFAR. In Figure 35 (Annex), I present the trends for these three facilities individually compared to public. All three PNFPs have either downward or flat trends in current on ART.

Figure 25: Trends in Current on ART in Transitioned Public and PNFP Facilities (All)

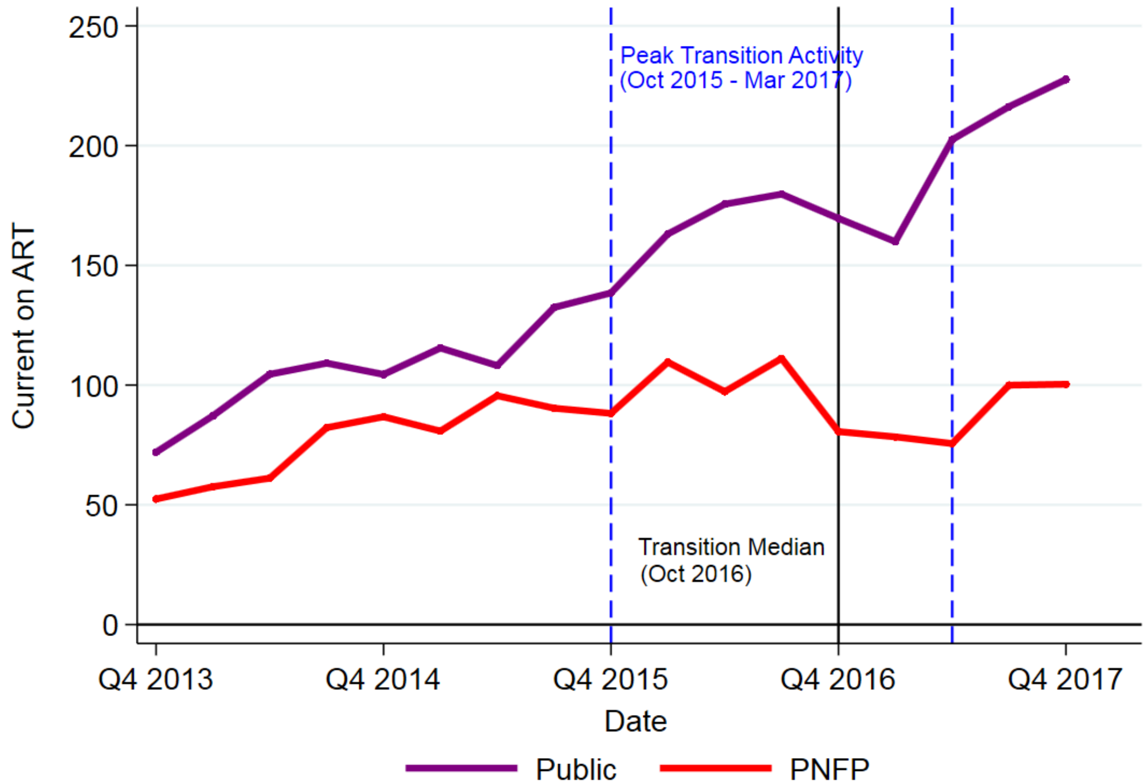


Figure 26: Trends in Current on ART (HC II & III)

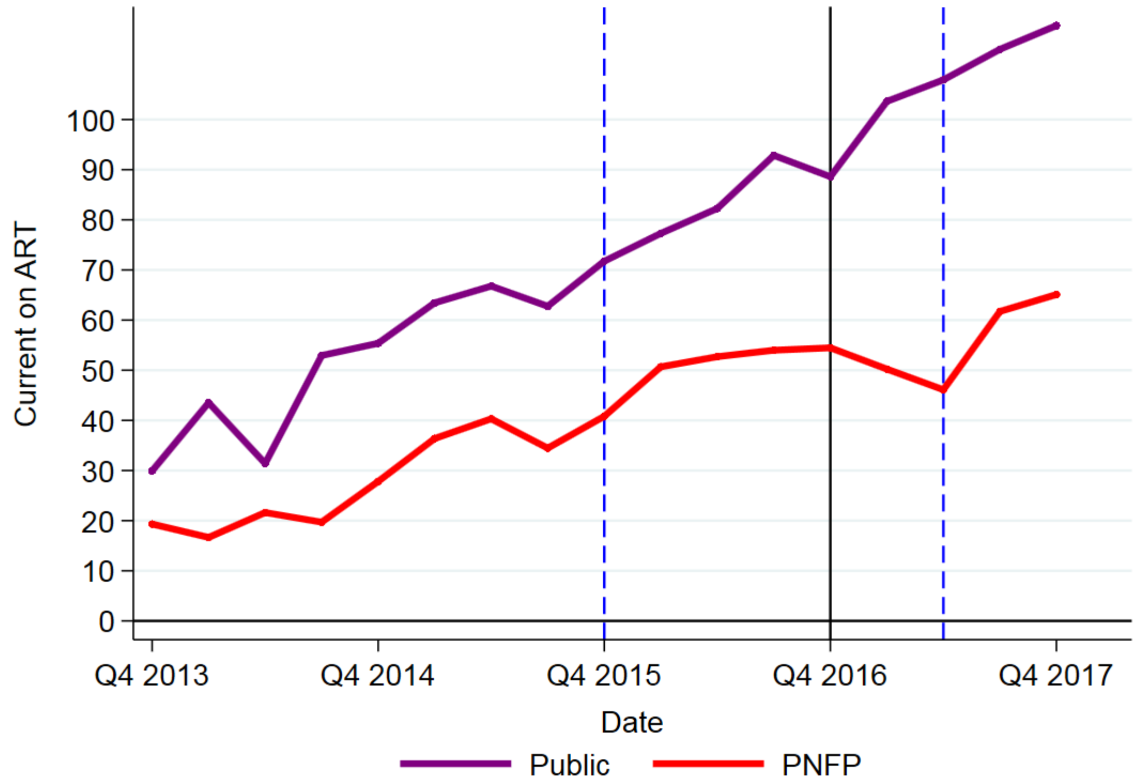
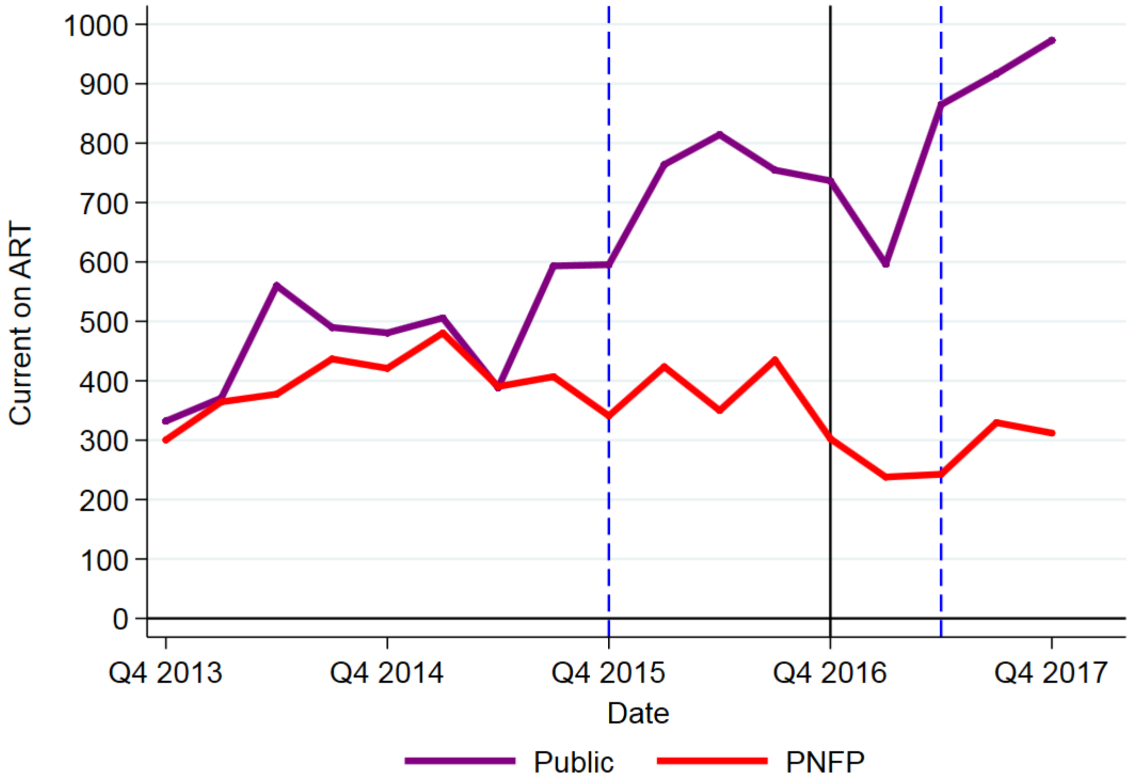


Figure 27: Trends in Current on ART (HC IV & Hospital)



There is no significant difference-in-difference in trend for PNFPs vs. public facilities in current on ART. This remains the case after disaggregating by level of facility or applying bootstrap confidence intervals. The D-in-D in trend further from the null (more negative) for the HC IV & Hospitals (IRR=0.955, 0.855–1.067, 0.413), as Figure 27 suggests, but the result was not statistically significant.

Table 38: Trend Analysis of Current on ART for PNFPs vs. Public

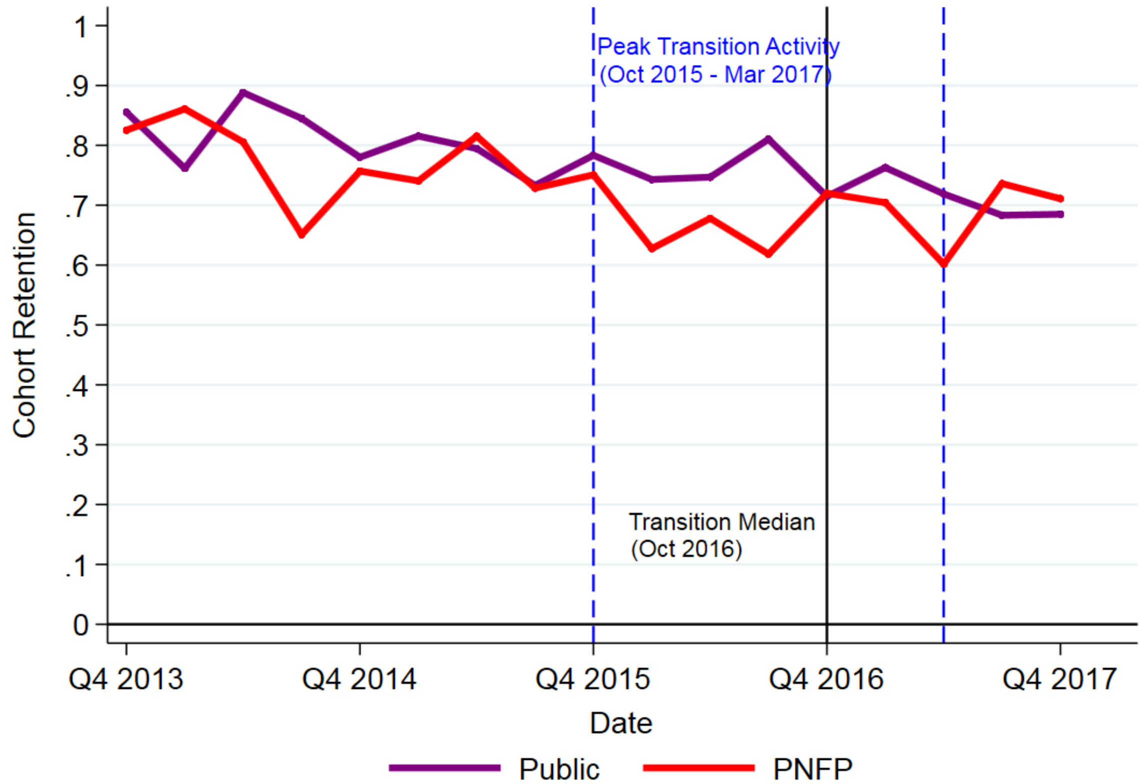
	Current on ART	Current on ART	Current on ART	Current on ART
Standard Errors	**Robust**	**Robust**	**Robust**	**Bootstrap**
Facility Levels	*All*	*HC II & III*	*HC IV & Hospitals*	*All*
	IRR (95% C.I.) p-value	**IRR (95% C.I.) p-value**	**IRR (95% C.I.) p-value**	**IRR (95% C.I.) p-value**
Level				
HC II & III vs. HC IV & Hospital	**11.12*** (6.10, 20.25) <0.001**			**11.12*** (5.77, 21.41) <0.001**
Ownership				
PNFP vs. Government	0.645 (0.362, 1.147) 0.135	0.569 (0.308, 1.051) 0.072	1.204 (0.393, 3.687) 0.745	0.803 (0.607, 1.062) 0.123
Trend:				
Pre-Trend	**1.088*** (1.073, 1.103) <0.001**	**1.101*** (1.085, 1.117) <0.001**	**1.025* (1.001, 1.050) 0.041**	**1.088*** (1.073, 1.103) <0.001**
Post-Trend	0.981 (0.938, 1.025) 0.388	0.970 (0.924, 1.019) 0.228	1.000 (0.946, 1.080) 0.993	0.981 (0.939, 1.024) 0.375
PNFP Trend	0.998 (0.963, 1.035) 0.915	1.006 (0.970, 1.043) 0.766	0.965 (0.926, 1.006) 0.095	0.998 (0.961, 1.037) 0.919
D-in-D in Trend	0.979 (0.908, 1.055) 0.577	0.978 (0.896, 1.067) 0.612	0.955 (0.855, 1.067) 0.413	0.979 (0.903, 1.061) 0.601
Constant	**16.00*** (12.32, 20.78) <0.001**	**14.53*** (11.06, 19.07) <0.001**	**274.68*** (142.68, 528.81) <0.001**	1.792 (0.903, 1.061) 0.184
N obs.:	**2,024**	**1,763**	**261**	**2,024**
N facilities:	**127**	**111**	**16**	**127**
Public	106	93	13	106
PNFP	21	18	3	21

*Notes: *p<0.05, **p<0.01, ***p<0.001.*

Footnote: HC: health centre; ART: antiretroviral therapy; IRR: incidence rate ratio; PNFP, private not for-profit.

In Figure 28, cohort retention has been declining over time at roughly equal rates for public and PNFP facilities.

Figure 28: Trends in Cohort Retention at Transitioned Public and PNFP Facilities



For cohort retention, the D-in-D for PNFPs was not significant (3.6 percentage points; -8.2, 15.4, p=0.553). This remains the case after disaggregating by level or using the bootstrap (Table 39). Varying the transition dates also did not change the interpretation (Annex: Table 58). Smaller facilities (HC II & III) have lower baseline cohort retention. The decline in cohort retention among reporting facilities during the study period is about 14 percentage points, and is consistent for small and large facilities.

Table 39: 12-month Cohort Retention for PNFPs vs. Public

	Preferred Model (Jan 2015 – Mar 2017)	**Preferred Model (Jan 2015 – Mar 2017)**	**Preferred Model (Jan 2015 – Mar 2017)**	**Preferred Model (Jan 2015 – Mar 2017)**
	Robust S.E.	**Robust S.E.**	**Robust S.E.**	**Bootstrap**
	All	*HC II & III*	*HC IV & Hospitals*	*All*
	Proportion (95% C.I.) p-value	**Proportion (95% C.I.) p-value**	**Proportion (95% C.I.) p-value**	**Proportion (95% C.I.) p-value**
Level				
HC II & III vs. HC IV & Hospital	**-0.128** (-0.205, -0.052) 0.001**			**-0.128** (-0.212, -0.045) 0.002**
Ownership				
PNFP vs. Government	-0.036 (-0.127, 0.055) 0.436	-0.017 (-0.121,0.087) 0.746	-0.130 (-0.298, 0.038) 0.129	-0.036 (-0.137, 0.065) 0.481
Post Transition	**-0.143*** (-0.202, -0.085) <0.001**	**-0.138*** (-0.195,-0.082) <0.001**	-0.154 (-0.337, 0.028) 0.097	**-0.143*** (-0.205, -0.082) <0.001**
D-in-D				
PNFP x Post Transition	0.036 (-0.082, 0.154) 0.553	0.043 (-0.093, 0.179) 0.535	0.012 (-0.254, 0.278) 0.929	0.036 (-0.077, 0.148) 0.481
Constant	**0.859*** (0.819, 0.900) <0.001**	**0.853*** (0.814, 0.891) <0.001**	**0.753*** (0.627, 0.878) <0.001**	**0.988*** (0.891, 1.085) <0.001**
N obs.:	**628**	**370**	**95**	**628**
N facilities:	**117**	**102**	**15**	**117**
Public	97	85	12	97
PNFP	20	17	3	20

*Notes: *p<0.05, **p<0.01, ***p<0.001.*

Footnote: HC: health centre; PNFP, private not for-profit.

4.5 Discussion

PNFPs experienced larger reductions in HIV supervision and receive no more attention from IPs after transition than public facilities. PNFP employees are more likely than public to report declining time spent on HIV care and there is limited evidence that PNFPs, especially large ones, are not keeping up with their public peers in the number of patients on ART, but the divergence in trends seems to pre-date transition and is not statistically significant.

Changes in support for PNFPs may be explained by their relative marginalization from government and lack of specialized attention from IPs. Continued IP visits, when they exist, did not favor public, PNFP, or PFP facilities. Lost supervision from IPs can be made up for through increased attention from district health offices (DHOs). However, PNFPs may be less of a priority than public facilities for DHOs providing supervision.

In a post-hoc analysis, PNFP in-charges are more likely than public facility in-charges to report "Loss of staff through their resignation or reassignment to other health facilities" since transition. This is distinct from the issue of terminations of health workers noted in the first paper of this thesis. Reporting loss of staff is positively associated with the transition impact index and marginally negatively associated with transition preparedness, making it plausible that transition itself is a driver of loss of staff. Elsewhere in the survey (not reported in this paper), PNFPs report more than twice the odds of a position in their HIV workforces having turnover since transition compared to public. It is possible that PNFP workers have more flexibility to respond to changing incentives than government health workers, and this is reflected in voluntary turnover of these health workers. However, higher turnover in PNFPs may be unrelated to transition. It is unclear whether the reported turnover results in less staffing. There are very few

PNFPs that report consistently to HRHIS, making the type of analysis of staffing ratios done in the first paper of this thesis impossible.

A second post-hoc finding relates to quality in PNFPs vs. public. PNFP in-charges are less likely than public facility in-charges to report declining quality of HIV care. That fewer PNFP facilities report declines in quality of HIV services may be due to initiatives by PNFP umbrella organizations, which have sought to improve quality in their member facilities in recent years (124). However, reported declines in quality of HIV services in public facilities may reflect in-charges' dissatisfaction with government support post-transition and their desire to depict their post-transition situation as dire to elicit a response from government. If PNFP know that they must cope without additional government support, they may be less inclined to misrepresent the situation.

While PNFPs seem able to maintain service delivery following transition, the sustainability of HIV service provision in PNFPs is uncertain. If PNFP coping mechanisms are exhausted, quality of HIV services in PNFPs may be affected. In the second paper of this dissertation, I question for how long transition facilities can maintain services following loss of support. This question is even more relevant for transition PNFPs, which have lost more supervision and staff than the typical transition facility. If HIV service provision by PNFPs proves unsustainable, patients will need to be transferred to public facilities with the recognition that these transfers have not always gone smoothly in the past (30, 73).

Although transition PNFPs report more annualized HIV-related training days per worker per year, the evidence is weak. Few facilities report any training and the method of annualizing the data (dividing training days by workers and time since transition) can result in large outliers, particularly among facilities that report transition recently. Bootstrap resampling, in which some resamples of the data will contain outliers and others will not, rejected statistical significance.

PFPs are not more likely than public facilities to have declining supervision and are less likely to experience disruptions of sputum testing. However, these may not be the most relevant metric for PFPs, which may have been more influenced by financial incentives not included in the analysis.

There is evidence that PFPs are disengaging from HIV care since transition, with discontinuation of HIV outreach, less staff time spent on HIV, and fewer testing and counseling visits performed relative to public facilities. Private providers play a major role in provision of HTC in urban populations and among higher-income groups, who prefer the service and anonymity of private facilities (120). From the Uganda Private Sector Assessment:

> Private facilities, particularly [PFPs] offering comprehensive services including HIV/AIDS, are a "one stop shop" that provide convenience, privacy, and flexibility. Some [PFP] practitioners described their ART clients as "walk-ins," and others reported that [PFP] facilities provided timesaving measures such as call-in ARV prescriptions for clients. (p. 129)

Furthermore, interviews conducted as part of the parent study with key informants and staff at one PFP facility revealed that fees for HTC had been introduced after transition and outreach visits ceased, which substantially decreased demand (H. Zakumumpa, personal communication, October 17, 2018). While patients may simply switch to nearby public facilities, many of which continue to receive PEPFAR support, some clients who prefer the privacy of PFPs may forgo testing altogether.

Considering the large role that the private sector has historically played in HIV care in Uganda (120, 122), there may be harms to a diminished role for PFPs in HIV care and a stagnating role for PNFPs. Advocates of private sector inclusion and public-private partnerships will be discouraged by these findings. However, there may be counteracting benefits for Uganda's HIV response. Increased consolidation of HIV services in the public sector could improve planning, coordination, and monitoring of outcomes. PFPs provided a sizable share of testing, but only a few offered ART, which meant that patients testing positive in PFPs required a referral to an ART facility. This was an impediment to "test-and-treat" policies. Furthermore, monitoring of services delivered by PFPs through routine reporting is particularly difficult, given that less than half of the PFPs once supported by PEPFAR reported to DHIS2.

4.5.1 Limitations

This analysis is limited by the small sample size of private facilities in our survey, which results in low power. Multiple comparisons risks inflating Type I error rates, thereby limiting our ability to test large numbers of hypotheses without identifying many false positives. In the facility survey, under conservative assumptions, I expect 0.68 false positive at a 1-<5% level and 0.17 false positives at the 1% level among our pre-specified hypotheses. This makes it likely that one out of four findings at the 1-<5% level (reduced outreach in PFPs, reduced time spent on HIV care in PNFPs, decreased disruptions of sputum testing in PNFPs, and reduced time spent on non-HIV care among PFPs) is spurious. It is possible, though unlikely, that any of the three pre-specified findings significant at the 1% level is spurious. The post-hoc findings should be considered with some skepticism as well.

The facility survey relies on self-report and recall by facility in-charges and workers, which may be subject to response and recall bias. Our analysis will only be biased if there is differential recall or response bias between private and public facilities. This may happen if private and public facility in-charges have differing rationales for misreporting outcomes. For example, our finding that PFPs are more likely to discontinue outreach would be biased if public in-charges were reluctant to report that they could no longer provide a valued service but PFPs in-charges were not.

It is also true that PFPs are concentrated in urban areas in Uganda, and our PFP sample comes almost exclusively two districts (Kampala and Wakiso) and were mostly previously supported by just one implementing partner. Differences between PFPs and public facilities could be specific to these districts and/or the IP involved.

Under-reporting of PFPs in DHIS2 is also a limitation. The facilities that report to DHIS2 are likely different from those that do not. However, it is a matter of debate whether reporting and non-reporting facilities will respond to transition differently. If the PFPs reporting to DHIS2 were those that had more capacity, they may also be better equipped to respond to transition. However, if reporting PFPs are those that relied on PEPFAR support more, they may well be more affected by transition.

The quality of DHIS2 data is also a limitation in our analysis. Systematic bias in DHIS2 reporting is likely to exist and could differ for facilities of differing ownership status. Constant over- or under-reporting would not affect our analysis, but differential changes in the quality of reporting would. For example, if training programs improve the quality of DHIS2 reporting in public facilities over time but not in private ones, our findings would be biased. The direction of the bias would depend on the extent of over or under-reporting at baseline.

Lastly, difference-in-difference analysis relies on assumption of parallel baseline trends and has been shown to have inflated Type I error rates. Excluding the months October 2013–Jan 2014 that have high testing activity by PFPs, the baseline trends for HTC in PFPs and public facilities appear parallel, albeit with noise, and the D-in-D remains significant for PFPs. I addressed concerns about inflating type I errors with D-in-D through 1) sensitivity analysis by varying the pre- and post-transition periods, and 2) bootstrap replication to account for auto-correlation, as recommended by Bertrand, Duflo, & Mullainathan (114). Despite these steps, estimates of effect modification by ownership should not be treated as estimates of the causal effect modification of ownership.

4.5.2 Conclusions & Implications

The declining role of PFPs in HIV provision and the decline in support to PNFPs in Uganda provide causes for concern. Although declining HIV testing in the (mostly) urban PFP facilities can be offset by increased testing in nearby public facilities, patients who prefer the accessibility and confidentiality of private providers may forgo testing altogether. Future population-based sero-prevalence studies, including the AIDS indicator Survey and the population-based AIDS impact assessments (PHIA) surveys, could determine if transition has led to less testing and more PLHIV unaware of their status among demographic groups that use PFPs.

The loss of supervision and staff reported by PNFPs following transition leads to concerns about the sustainability of HIV care provided at PNFPs. PNFPs often serve remote areas that lack equivalently-equipped public facilities, making it difficult for patients to go elsewhere. If transitioned PNFPs stop enrolling patients on ART, “ART-deserts” may result in some rural areas, affecting access to treatment.

With declining global donor funding for HIV/AIDS (1), more transitions are likely in the future. Private facilities serve different segments of the population and are likely to experience transition differently than public facilities, and their needs should be considered in transition planning. Maintaining supervision following transition of private providers requires mechanisms to extend public supervision to private facilities or to enable private umbrella organizations (e.g. UPMB) to supervise their members. Future research should address the experiences of patients that use private providers and understand their needs and outcomes in transition.

Chapter 5. Conclusions & Policy Implications

5.1 Summary of results

In the preceding three papers, I present some negative impacts of transition. The termination of lay health workers and the probable reduction in training are the most problematic, among the impacts on human resources. Perceptions among staff in transition facilities of worsening access and quality of care are also a cause for concern, especially if they are ultimately confirmed by service volume data. Other important negative effects include the diminished role of the private sector, particularly PFPs, with the potential decline in testing by their clients. Transition has put PNFPs under increased strain, with reduced supervision and potentially fewer staff than public facilities.

Among the positive findings, there is a lack of evidence that transition has negatively impacted service volume. In addition, staffing levels and worker motivation do not appear to have been affected by transition. Even if transition facilities eventually fall behind maintenance facilities to some degree, it is important to note that HIV services have not collapsed immediately following loss of PEPFAR support — a positive result in and of itself.

5.1.1 Comparing Hypotheses and Results

The findings from the preceding three papers both agree with and contrast with the hypotheses that I outlined in the Introduction.

Table *40* compares the findings to the hypotheses. When workers in transition facilities lost incentives, they did not leave their posts or become less motivated, contrary to my expectations. Coping mechanisms may have lessened the impact of transition, or workers may not have had sufficient time to respond to transition to become demotivated or leave.

There is also no evidence that workers shifted time from HIV to non-HIV care. Although transition workers do report spending less time on HIV relative to other services, they do not differ significantly in their reported changes in time spent on non-HIV care, relative to maintenance workers. Transition workers also reported a decline in time spent in training (as well as meetings and reporting); however, I did not capture clear changes in quality of HIV care, other than in the perceptions of facility in-charges.

Transition in-charges were more likely to report worsening access to HIV care and loss of outreach. The expected outcome of discontinuation of outreach, reduced access to HIV services, and declining time-allocation for HIV in transition facilities is reduced volume of HIV services. However, these effects were not observed using the DHIS2 data, possibly because they might only appear in the longer-term.

In the third paper, I found that HIV testing decreased in PFPs relative to public facilities, suggesting a change in the private-public mixture. Transition PNFPs, especially large PNFPs, were not keeping up with transition public facilities in current on ART, but this trend preceded the PEPFAR GP. Ultimately, PNFPs may play a smaller role in provision of ART in the future for reasons unrelated to transition. Decentralization of HIV care in the public sector increased the number of access points, which might have led more new and continuing ART patients to seek care from a nearby public facility rather than distant PNFPs.

Table 40: Comparing Hypothesized Transition Outcomes to Study Findings

Health System Domain	Impact	Possible Transition Outcomes	Findings
Health Workforce	**Distribution**	Loss of incentives causes staff to leave transition facilities	• Official cadre have not left public transitioned facilities • Lay health worker cadres have been affected by terminations of staff, which is occurring only in transition facilities
	Motivation	Loss of Incentives results in less productivity (through absenteeism) or decline in responsiveness	• Transition did result in loss of incentives • However, transition workers are not less motivated than their peers in maintenance • Absenteeism (not reported) did not differ significantly between maintenance and transition • The expected impacts on HIV and non-HIV service delivery were not observed in the short-term
	Training & Mentoring	Decline in frequency of HIV training and indirect effects on non-HIV skills	• There was some evidence that training declined in transition • In-charges in transition reported worsening or less improvement in quality • Expected impacts on quality of services examined through DHIS2 were not found
Service Delivery	**Service Delivery/Capacity & Utilization**	Discontinuation of HIV services in transitioned facilities	• More than half of transitioned facilities report discontinuation of outreach compared to only one maintenance facility • Other HIV services were unaffected • Despite this, trends in HTC, ART, and cohort retention were not different
		Access barriers or reduced attention to HIV services result in reduced utilization of HIV Services	• Transition facility staff spend less time on HIV but <u>not</u> more time on non-HIV care • In-charges report reduced access to HIV care • Reductions in utilization were not observed for HIV or non-HIV services
	Public/ Private Mix (PFPs & PNFPs)	Private facilities discontinue or seek cost recovery for HIV	• PFPs do appear to be reducing HIV service volume, availability of outreach, and HIV time-allocation • PNFP workers report spending less time on HIV at a higher rate than public, but PNFPs have not deviated from their pre-transition service delivery trends

Footnotes: ART, antiretroviral therapy; DHIS2, district health information system 2.0; HIV, human immunodeficiency virus; PNFP, private not for-profit; PFP, private for-profit.

5.1.2 Discussion of GP Findings in Uganda

The evidence presented across these papers suggests that the GP in Uganda has had the expected negative impacts on the support for facilities and the services that rely heavily on that support (i.e. HIV outreach). However, downstream activities — such as enrollment and retention of patients on ART — have not been affected. This presents a conundrum.

While more evidence is needed; two possible interpretations exist at this time. First, the negative perceptions reported by in-charges may only be perceptions. Negative health worker perceptions may be driven by temporary panic or deliberate mis-representation of the situation to survey enumerators. However, it is also possible that negative impacts have occurred or will occur but are not observable with presently available data. I lean towards the former argument: transition has put strain on the health system, which is reflected in changing inputs and perceptions of access and quality, but the health system is exhibiting some resilience.

Resiliency in the face of transition could result from multiple sources. First, past donor investments in training, infrastructure, and systems may be paying dividends that make up for lost support. Norms established over the past 15 plus years of PEPFAR programming have likely remained in place. However, it remains to be seen whether past investments are self-sustaining or depreciate over time. Increased resource mobilization, most likely to come from the national government of Uganda, will be critical to maintaining health system performance in the long-run.

5.2 A Note on the Context and Transition Process

The results presented in this thesis occurred in spite of a hasty, complicated, and one-sided transition process. The GP sought to transition facilities from PEPFAR to “central support”; however, PEPFAR never defined what “central support” would mean, and the instructions provided to missions in COP guidance did not include how to engage national stakeholders in transition planning (4). In fact, there was no joint planning process at all in Uganda. A “Transition Task Force” was formed, but it never met (L. Paina, personal communication, March 16, 2018). In part, this was due to the mistaken notion that the facilities to be transitioned were “low volume” and, hence, unimportant. This is only partly true. Many high-volume facilities were transitioned in the 10 central support districts. Furthermore, the data used for identifying “low-volume” facilities for transition was incomplete and often erroneous.

The negative impacts of transition were generally predictable. PEPFAR IPs led supervision visits and paid for health workers’ training and salaries. Withdrawing PEPFAR support resulted in less supervision, training, and fewer (lay) health workers. Yet, PEPFAR made little effort to ensure that the support it provided would be made up from other sources.

However, the lack of planning on PEPFAR’s part is not shocking to me. First, that service delivery did not collapse following PEPFAR transition is evidence that PEPFAR’s support may not have been as vital to the health facilities as some critics have assumed. The Foundation for AIDS Research (amfAR) predicted that a 5.6% decrease in global U.S. HIV/AIDS funding would result in 253,000 patients experiencing disruption of treatment globally (135), yet, in Uganda, transition facilities have lost nearly all of their site-level support and have still been able to keep pace with their maintenance counterparts.

Secondly, donor health programs exist to temporarily provide the support to the health system that domestic government and private resources cannot. The ultimate responsibility for the health system rests with the national government. While PEPFAR should have initiated planning for transition early on, the Government of Uganda (GoU) had 11 years between PEPFAR’s entry in 2004 and the start of GP in 2015 to prepare for PEPFAR’s inevitable withdrawal. The burden of ensuring a smooth transition, and the blame for a lack of a transition plan, rests with both PEPFAR and GoU.

The Government of Uganda could have had better systems for absorbing lay health workers and providing training, and these remain vital as PEPFAR and donors consider further scale-backs. However, it likely made sense for the GoU not to fill all gaps in support created by transition. Where PEPFAR and other donors were willing to spend heavily, the GoU allowed them to do so. It would not be feasible for Uganda to provide the same level of support to HIV that PEPFAR itself, through the GP process, has determined to be excessive. GoU has focused its limited resources on health system strengthening more broadly, and the country has made steady progress on health indicators unrelated to diseases targeted by PEPFAR. Therefore, some loss of support for HIV is to be expected in transition, though it did not need to result in termination of lay health workers.

However, even for a low-income country, GoU could be doing more to support its health system. In 2014, the GoU spent only 10.8% of its budget on health, far below the Abuja declaration goal of 15% (13). The limited fiscal space in Uganda's health budget makes it more difficult to cope with the loss of donor support. This was in evidence in 2017, when the government sought to cut the health budget at the same time as donor support was declining and treatment needs have been growing, leading to a shortfall in funding for ARVs (136). Rwanda, despite also being a low-income country, spent 23.8% of its government budget on health care in 2014 (13). Rwanda has coped with declining PEPFAR support while successfully scaling-up ART (70) and has exceeded the second 90-90-90 target with 83% of PLHIV on ART (137) compared to Uganda's 72% (11). Rwanda is an exceptional case, but it demonstrates what is possible in a low-income country with adequate resources and coordination.

5.3 Lessons for Transitions in other Settings

Going beyond the GP experience in Uganda, there are relevant lessons for transitions in other settings. The PEPFAR GP is likely only the beginning for transitions of GHIs. Declining donor funding for HIV (1) coupled with expanding treatment targets under the 90-90-90 goals make increasing the domestic share of HIV expenditure necessary. While transition and/or increased co-financing of health programs may seem inevitable, the PEPFAR GP experience suggests that preparedness is lacking from both donors and government.

5.3.1 Lessons from the GP Model: Suddenness

In the PEPFAR GP process, COP directives announcing the PEPFAR GP came from Washington, D.C. in 2015. Country missions made COP plans in 2015 and were expected to implement them by October 2016 (i.e. the end of FY2016). This compressed transition timeline did not permit appropriate stakeholder engagement or transition planning. As noted previously, the “Transition Task Force” in Uganda never met. This is not an exceptional experience; in 2011 PEPFAR announced to Namibia that they would be scaling-down support immediately without prior consultation (97). The Government of Namibia had no transition plan until support was already being scaled-back. While the GFATM has a multi-year transition planning process with clear staging and criteria (138), the transition timeline depends on having adequate resources to gradually phase out support. The GFATM has a three-year budget horizon, and all eyes should be on the 2019 replenishment for 2020–2022.

Recent U.S. budget proposals with large cuts to foreign assistance have been rejected by Congress (139), but if donor cuts do come, many U.S. and multi-lateral programs will need to be scaled-back on a rapid timescale. Therefore, the suddenness and the lack of attention to transition planning seen in Uganda may well appear in future transitions.

5.3.2 Lessons from the GP Model: Prioritization

PEPFAR prioritized facilities and sub-national units for transition based on cost-effectiveness and contribution to the national HIV response. Prioritizing support at the subnational level makes sense from a programmatic perspective; it is more cost-effective to provide resources where the largest number of recipients are to be found. However, the process in Uganda identified districts for transition in Northern and Eastern regions that were among the poorest in Uganda and that were often newly-established districts lacking capacity. Prioritization has the potential to exacerbate existing inequalities in access to care. Areas with low HIV prevalence are often remote and hard to reach. Donors may well not see the programmatic benefits as being worth the costs and decide to transition these areas first. National governments could and should step in to make up for this support, but this does not appear to have happened in Uganda, and it cannot be assumed that governments struggling to provide basic services in already marginalized areas will be able to also replace lost donor support following transition.

Another issue with prioritization emerges when multiple donors (or donors and government) decide to prioritize their support simultaneously. USAID has also prioritized its MNCH programs in Kenya at the same time as both PEPFAR and the Government of Kenya were doing so for HIV (D. Rodríguez, personal communication, March 16, 2018). Having multiple and overlapping actors simultaneously prioritizing their support increases the complexity and risks of transition and has the potential to further marginalize remote regions.

5.3.3 Lessons from the GP Model: Transition to Central Support

Another element of the GP model likely to be relevant in the future is a transition of site-level support while leaving “above site” support in place. This element has appeared in prior

PEPFAR transitions Southern Africa (32) and Rwanda (70), where site-level support was channeled through central government budget support.

This model has good features for ownership and coordination of the HIV response. By centralizing the allocation of funding and decision-making, the central support model invests in the capacity of the national health systems and has the potential to be more sustainable than direct service delivery. However, the above-site support model also has three key limitations.

First, the central support model relies on national systems that may not be able or willing to perform all of the functions that donors provided prior to transition. Established vertical systems may not easily be integrated into or replaced by national programs. An example of this in Uganda was that there was no national, paid community health worker program to absorb the lay health workers supported by departing PEPFAR IPs. IPs have the resources and flexibility to fill gaps in government support at the site level, going so far as to print data collection tools when government of Uganda ran out of stock or replace tires on government vehicles. Government budgeting and procurement processes are often far less flexible and responsive to health system needs than those of PEPFAR IPs.

Another problem with the central support model is that support to national systems is not helpful if facilities cannot access those systems. In the PEPFAR GP, support for lab hubs remained in place, but funding for transport riders to collect samples and airtime for health workers to download test results were affected by transition. This resulted in increased disruption in viral load testing in transition facilities until patchwork solutions were implemented to alleviate the problem (L. Paina & D. Rodríguez, personal communication, March 16, 2018). In a similar vein, PEPFAR's support for workers to attend trainings was instrumental in them getting trained. Supporting training at the national level will not be helpful if workers cannot travel.

During transition, donors and governments will need to institutionalize the support donors provided. While it would be difficult for low-income nations to adopt donor-supported functions wholesale, they can also adapt them to increase cost-effectiveness. An example of this is cascading training of the trainers (TTT), which reduces travel costs.

5.3.4 Lessons from the GP Model: Summary

In Summary, the GP model has positive aspects, especially when compared with an abrupt termination of programs or an untargeted scale-back in support. However, the limitations of the model noted in the Ugandan GP experience offer lessons for its use elsewhere. Not all donor systems can be integrated into national systems, and bridge support may be required to maintain vertical systems until a more sustainable solution can be found. Critical gaps between national systems and health providers, such as the reliance on donors to maintain lab transit riders, should be identified and addressed as a part of transition planning. Transition planning should also include all major stakeholders, including other donors, to avoid simultaneous prioritization and ensure agreement on post-transition roles. Government has a specific role in supporting equity following transition, which can be worsened by prioritization of support.

For researchers, the GP model presents an excellent opportunity to study the effects of transition at the sub-national and facility levels by using units that continue to receive support as controls. However, researchers should remember that geographic factors and facility volume are often selection criteria and address confounding and selection bias in their analyses. However, as donors are unlikely to employ randomization of transition, the GP model remains one of the best designs for rigorous impact evaluation.

5.3.5 Lessons from PEPFAR GP's Results, with Caveats

Despite the loss of support and the disruption of outreach in Uganda, there were no notable impacts of transition on service volume. This is despite PEPFAR's large role in the Ugandan health sector, including transitioned facilities. In settings with stronger health systems and less donor dependence than Uganda, a total collapse of HIV services should not, in general, be expected immediately following transition. If transitioned facilities in Uganda continue to keep pace with those still supported by PEPFAR over the coming years, it will be evidence that transition has potential for increasing national control while maintaining progress. Yet, any evidence derived from the GP in Uganda need to come with several limitations.

The transition process in Uganda hardly represents a repeatable controlled experiment — much less a randomized controlled experiment. The rushed implementation of the PEPFAR GP and the reliance on incomplete and inaccurate data for making investment decisions are not the hallmarks of a good transition process, regardless of the outcomes. I recommend more careful design and implementation of future transitions with prospective evaluation to further build the evidence base. This requires some openness to experimenting with transition, and I counsel cautious optimism about the potential for sustainable transition of HIV programs.

However, my cautious optimism about transition comes with two important caveats. First, above site support, particularly for commodities, has been critical to maintaining progress in Uganda, and will be so for other countries that lack the financial resources and technical capacity to maintain commodity supply and lab systems. Had PEPFAR and the Global Funds not continued to help procure ARVs in 2017, it is unlikely that treatment would have continued to increase.

Secondly, sustained service delivery following transition relies on political will. Treatment for HIV has political support in Uganda, but some HIV prevention approaches do not. Uganda's criminalization of homosexuality and sex work make it unlikely that the government would sustain programs targeted to key populations (KPs). The GP retained PEPFAR support for KP programming in Uganda; however, in other transition experiences, such as GFATM's transition in Eastern Europe and the PEPFAR transition in the Eastern Caribbean (28, 71), KP programs were transitioned to socially conservative governments that were uninterested in supporting them, with disastrous results. This will not always be the case; in the Avahan transition experience, the Government of India was willing to continue supporting KP programs after support from the Bill and Melinda Gates Foundation ended support (25). However, KP programming should always be handled with caution in transition (75).

Finally, in opting for cautious optimism, I am making assumptions about the potential benefits of transition and setting them against the possible harms. These potential benefits include increased national ownership and coordination of the HIV response, and, possibly, efficiencies from horizontal integration of health services. These effects, in turn, can lead to a virtuous sociopolitical cycle: when tax-financed systems, not donors, are recognized as the source of health services, citizens advocate for greater domestic resource mobilization and better management of health funds. The parent study for this project was not designed to capture these benefits, which will only accrue over the long-term. However, the dividends from transition can and should be assessed empirically. If they do not emerge, the pain of transition, temporary or not, will not have offsetting merits for LMICs. Therefore, a considerable amount of additional research is needed before we can assess both the harms and benefits of transitioning global health programs.

Chapter 6. Annex

6.1 *Annex for Introduction*

6.1.1 Search Terms for Review of Conceptual Frameworks

I performed a non-systematic review of the literature to identify studies containing conceptual frameworks of indirect health system effects from all vertical health programs, of which HIV programs are a large component. The search combined three sets of controlled terminology and keywords: 1.) terms related to "conceptual frameworks", 2.) "health systems" terms, and 3.) terms identifying low and middle income countries. Due to the large number of potential terms related to vertical programs, including HIV programs, identification of relevant articles was performed during the title/abstract screening phase.

The search was initially designed for PubMed and repeated in Embase using adapted controlled terminology, as well as in Scopus and Africa-wide Information, using keyword searches. Across the four databases, the search resulted in 2,933 citations. Five articles were identified through review of the PHRplus database (http://www.phrplus.org/pubs_new.html), a search of the gray literature, and through consultation with subject matter experts (S. Bennett & D. Rodríguez). After de-duplication, a total 2,579 citations remained. Titles and abstracts of citations were reviewed for evidence that the studies contain a conceptual model on the indirect impacts of HIV programs on health systems. Full text was reviewed for 38 articles, and seven studies (52, 76-81) were deemed relevant.

6.1.2 Sample Size Calculation

The number of primary sampling units and facilities was chosen as a result of 1,000 Monte Carlo simulations. In each simulation, I applied hypothetical scenarios to the facility list in

Uganda. I created the clusters from districts, lumping and splitting districts to obtain 8-19 facilities per cluster. I sampled these clusters and applied random binary data using various assumptions about the proportion of facilities to change their responses during transition. I used a randomization process to produce responses for facilities that induced an average intra-class correlation coefficient (ICC) of approximately 0.30 at the district level across simulations. This would correspond to localized variation in response to transition that would occur if district health offices undertook to support transitioned facilities, but not in all districts.

Initially, the sample size calculation was designed for a two-wave survey of transition facilities only. I sought to have 80% power to detect a shift in responses among the transition facilities of 30% of sampled facilities with a 4:1 ratio of Yes-to-No compared to No-to-Yes (or vice-versa) changes at a 5% Type-I error level using McNemar's test. This required a minimum sample size of 135 facilities.

Later, the survey design was changed from two-wave to retrospective recall, and we included a maintenance facility comparison group. I sought to achieve a 2:1 ratio of CS to maintenance facilities to allow for comparisons within transition facilities as well as between maintenance facilities and transition facilities. This required adding another 68 facilities to the sample for a total sample size of 203 with a target of 135 transition and 68 maintenance facilities.

Table 41: Power Simulation Results

Overall Power Rate Using Cluster-based Sampling												
Mean N Facilities	**20% Shift**				**30% Shift**				**40% Shift**			
	Ratio = 4		**Ratio = 9**		**Ratio = 4**		**Ratio = 9**		**Ratio = 3**		**Ratio = 9**	
	α=0.01	**α=0.05**	**α=0.01**	**α=0.05**	**α=0.01**	**α=0.05**	**α=0.01**	**α=0.05**	**α=0.01**	**α=0.05**	**α=0.01**	**α=0.05**
67.7	0.218	0.295	0.311	0.437	0.196	0.350	0.255	0.466	0.196	0.319	0.297	0.52
89.6	0.143	0.472	0.25	0.669	0.155	0.459	0.300	0.703	0.103	0.336	0.414	**0.811**
111.8	0.328	0.673	0.603	**0.882**	0.293	0.638	0.625	**0.919**	0.192	0.496	0.746	**0.982**
134.4	0.528	**0.825**	**0.819**	**0.977**	0.475	**0.81**	**0.851**	**0.982**	0.294	0.664	**0.909**	**1**
156.4	0.686	**0.93**	**0.946**	**0.999**	0.676	**0.925**	**0.974**	**1**	0.495	***0.82***	**0.997**	**1**
178.8	**0.872**	**0.981**	**0.997**	**1**	**0.866**	**0.986**	**0.999**	**1**	0.714	**0.957**	**1**	**1**

Ultimately, the survey team limited the sample to Northern and Eastern Uganda as well as Kampala & Wakiso. Limiting the sampling area reduced travel costs, and resources were adequate for a larger target sample size of 250. However, the reduced sample frame resulted in a very different survey design. Furthermore, many assumptions made in the power simulation were not borne out in the data. First, we identified far fewer maintenance facilities than we expected in our sample (20 vs. 70-80). Secondly, 14% of facilities reported no recent PEPFAR support and were excluded. Therefore, the power simulation is presented to explain the initial considerations for sample size, not to indicate the power in our resulting sample.

6.2 Annex: Paper 1

6.2.1 Equation 1:

$$E(y_{it}|Z_j, u_j) = u_j + \beta_0 + \beta_1 \times L_j + \beta_2 \times R_j + \beta_3 \times T_i + \beta_4 \times P_t + \beta_5 \times P_t \times T_i + \beta_6 \times P_t \times L_j + \beta_7 \times P_t \times R_j \qquad \textbf{(Eq. 1)}$$

Where,
$u_j \sim N(0, \tau^2)$

In Equation 1, y_{it}, represents the staffing ratio for facility of type, indexed by i, at time t. The random intercept for each facility, u_j, is indexed by j, the facility identifier. The random intercepts are assumed to be normally distributed with mean zero. There is an overall intercept,

β_0, that represents baseline staffing levels in the maintenance group reference categories for region and level. I include a fixed effect for level, L, and region, R, to improve the fit of the model. The coefficient β_3 represents the baseline difference in staffing levels for transition facilities and β_4 represents the change in staffing levels for maintenance facilities. The difference-in-difference is represented by the interaction term coefficient, β_5. Additional interaction terms for level x post, $P_t \times L_j$, and region x post, $P_t \times R_j$, address confounding by region and level in the changes in staffing ratios over the period.

6.2.2 Paper 1 – Additional Tables & Figures

Table 42: Facility Survey Descriptive Statistics (Weighted Proportions)

	Transition (N = 206)	**Maintenance (N = 20)**
Level	%	%
HC II, Clinic	32.4%	37.7%
HC III	57.7%	27.7%
HC IV	6.2%	5.2%
Hospital	3.7%	19.4%
Owner		
Public	61.5%	69.1%
Private Not for-Profit	14.6%	27.7%
Private for-Profit	23.9%	3.1%
Services		
Offers ART	62.8%	72.6%
Offers Deliveries	80.2%	75.7%
District		
Central Support	21.7%	29.4%
New District	11.3%	0%

Table 43: Binomial Logistics Model of Salary Support

Binomial Logistic Model:	**Salary Paid by PEPFAR IP**
	OR (95% C.I.) p-value
Transition Facility vs. Maintenance Facility	1.387 (0.227, 8.492) 0.723
Post Transition	0.337 (0.068, 1.681) 0.185
Transition Facility x Post Transition	0.141 (0.015, 1.330) 0.087
Survey Strata	
Purposively Selected Districts	Ref.
Random Sample of Central Support and Maintenance	**3.084* (1.205, 7.893) 0.019**
Random Sample of Scale-Up Districts	4.706 (0.960, 23.07) 0.056
Constant	**0.009*** (0.002, 0.047) <0.001**
N facilities	226

*p<0.05, **p<0.01, ***p<0.001

Model adjusts for clustering at the district level and includes weights, per model-based analysis.

Figure 29: All Cadre Staffing Trends in PEPFAR Facilities by Region (Full Sample)

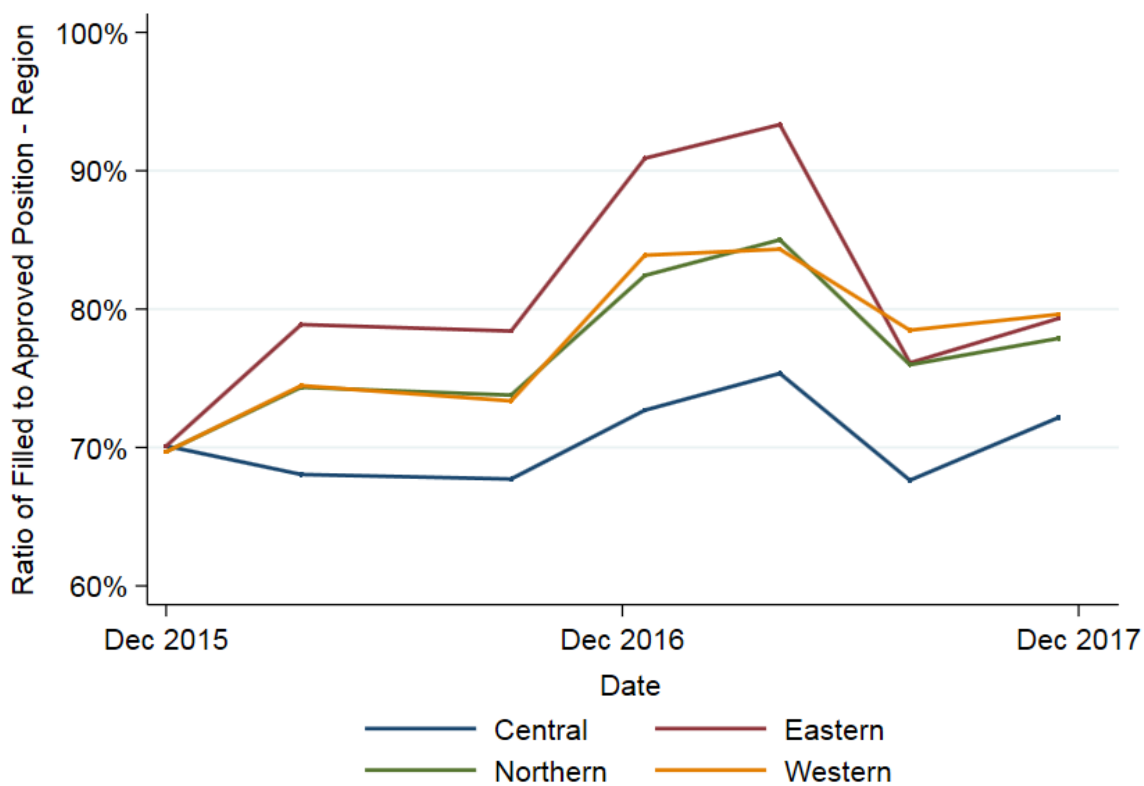


Figure 30: All Cadre Staffing Trends in PEPFAR Facilities by Level (Full Sample)

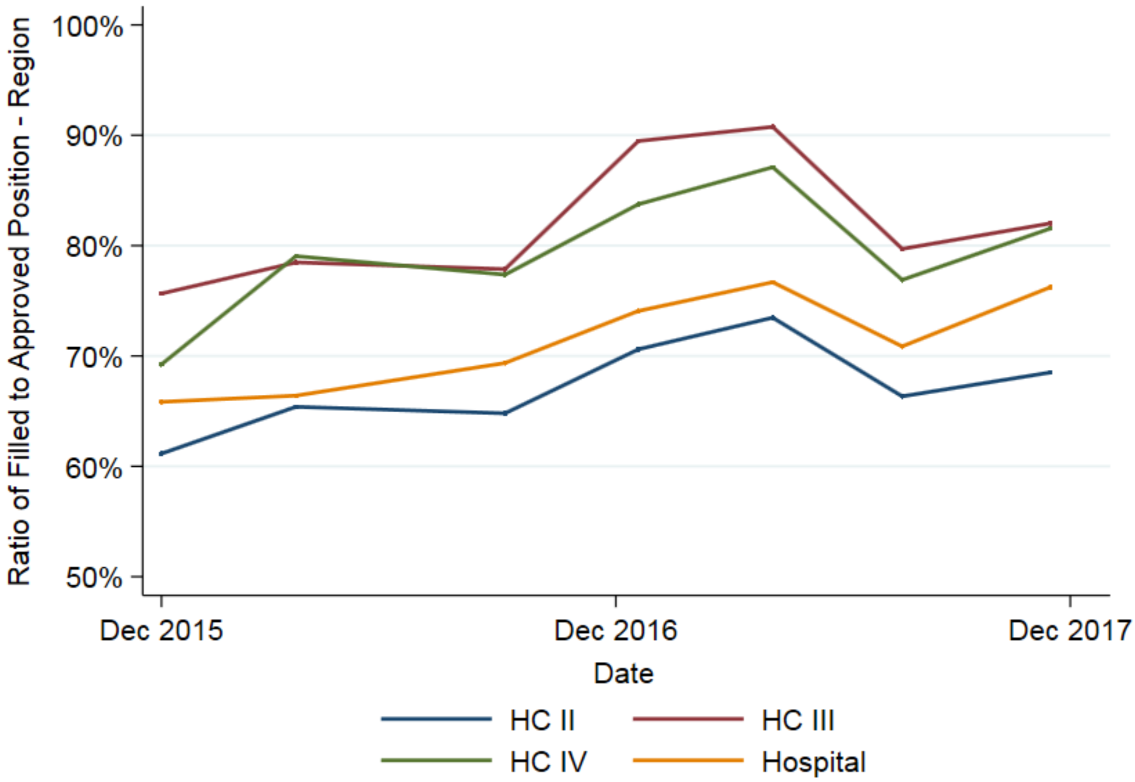


Figure 31: Histogram of Filled-to-Approved Ratio (All Cadre)

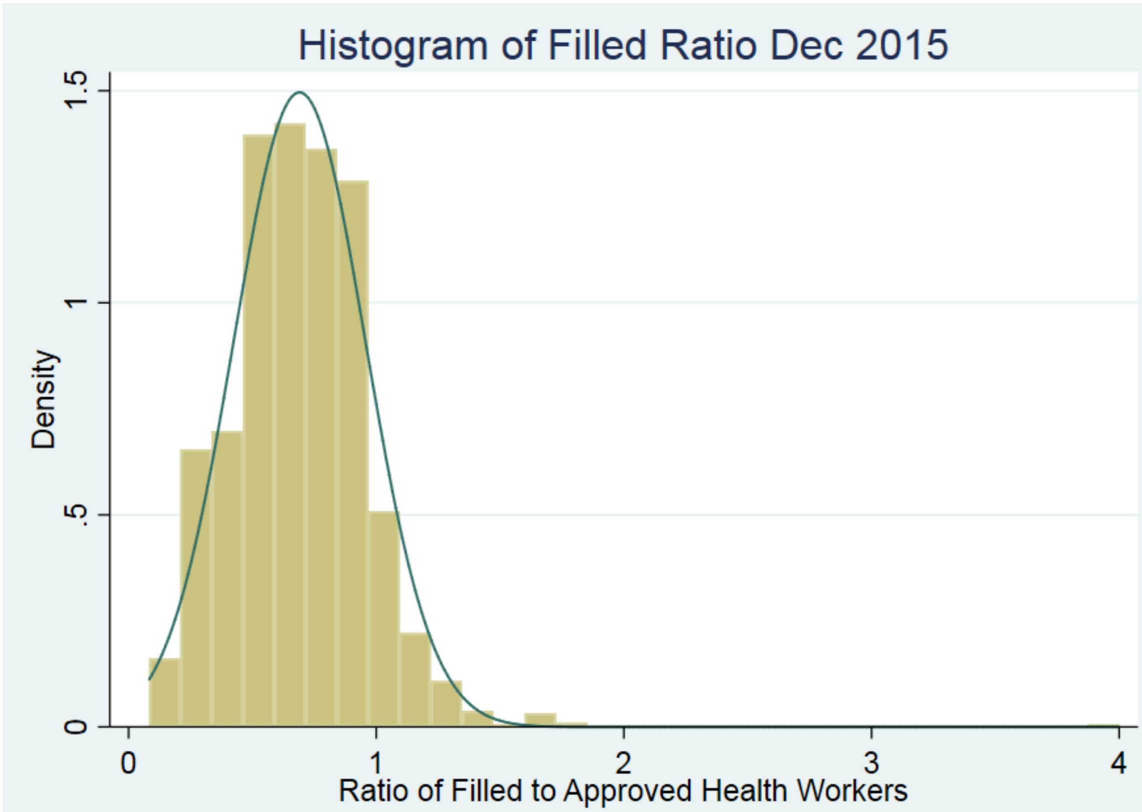


Figure 32: Histogram of Nurse and Midwives Staffing Ratios

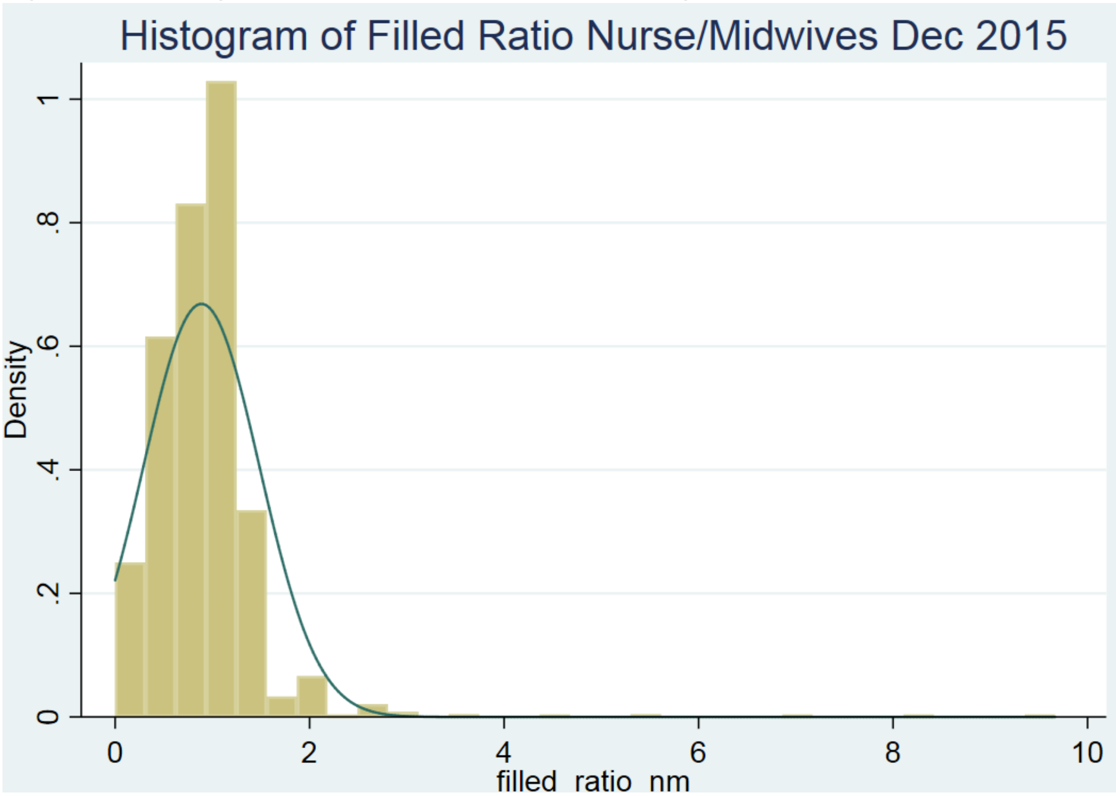


Figure 33: Nurse and Midwife Staffing by Region (Full Sample)

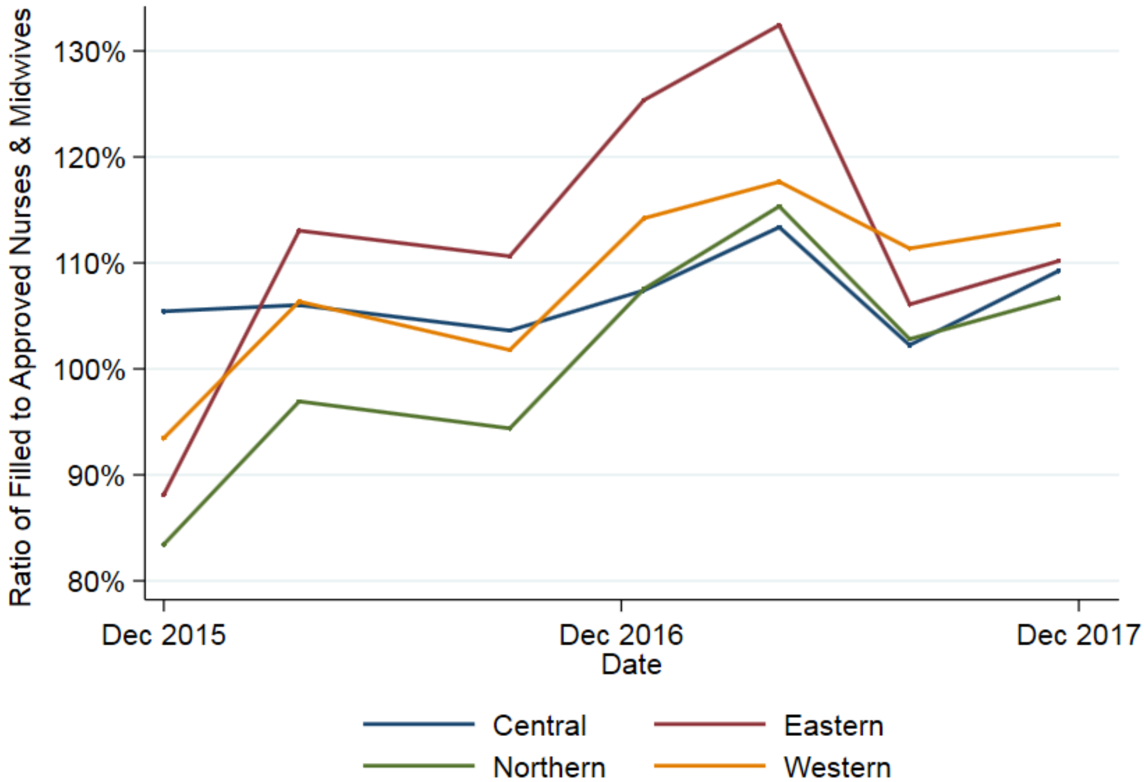
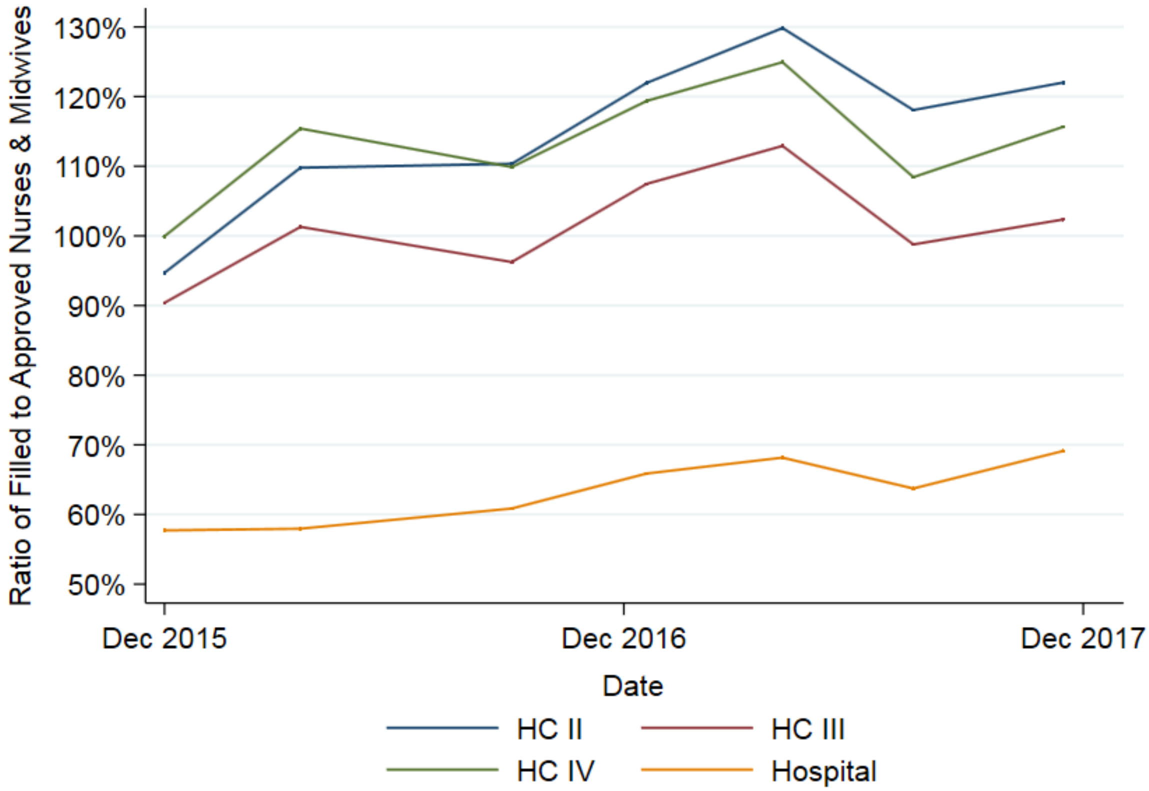


Figure 34: Nurse and Midwife Staffing by Level (Full Sample)



6.3 *Annex: Paper 2*

6.3.1 Rationale for Indicators

HIV testing remains a key component of Uganda's HIV Cascade as 19% of PLHIV do not know their status in 2017 (115) compared to the 90-90-90 goals of having 90% of PLHIV know their status (5). Under "test-and-treat", which has been implemented across Uganda, expansion of current on ART is expected and necessary to reach the second goal of having 81% of PLHIV on treatment. Retention on treatment — preferably low-cost, first-line treatment — is a necessary condition for the third 90 goal, 72% of PLHIV virally suppressed. A 12-month cohort period was chosen as it is more responsive than a longer period while being more sensitive to quality of care than a 6-month cohort retention indicator.

Outpatient department visits (OPD) is a catchall indicator that is sensitive both to demand (illness, health seeking behavior) and supply-side factors (staff shortages, delays in care). It includes both HIV care visits, MNCH care, and unrelated non-HIV care (e.g. injuries). Therefore, OPD is a non-specific metric for health facility performance. In Uganda, OPD has the disadvantage of being highly seasonal, as it responds to seasonal shifts in malaria incidence. However, it is a commonly used metric of other studies of the effect of HIV programs on health systems in Uganda (67, 68).

Coverage of 4+ ANC visits was selected as a measure of ANC quality. ANC visits serve as a platform for important interventions — including HIV testing and intermittent prophylaxis treatment (IPT) — that have direct impacts on maternal, fetal, and child health. In Uganda, nearly all women obtain ANC during pregnancy, but fewer complete the recommended four or more visits. Most seek ANC from a nearby public or private provider (116). Therefore, ANC1 is a good proxy for pregnant women in the catchment area of the facility. The ratio ANC4+/ANC1 is a proxy for the proportion of pregnant women who complete ANC at the same facility. However, pregnant women may be referred to another facility, especially if they are HIV+ and the facility does not provide PMTCT. Also, women do not generally receive their fourth and first ANC visits in the same month. Therefore, dividing the count of ANC4+ by the number of ANC1 visits in the same month is only a rough estimate even when averaging over many facilities.

Malaria is endemic or epidemic in all areas of Uganda (140), and two-doses of intermittent prophylactic treatment during pregnancy (IPTp) for malaria are recommended for reduction of maternal mortality and morbidity associated with infection during pregnancy. The standard drug for IPTp is Sulfadoxine-Pyrimethamine (Fansidar), which can only be administered after the first trimester. Delivery of IPTp can be interrupted by not attending ANC, by having a stock-out of SP, by health workers not dispensing IPTp during the ANC visit, or by patients not consuming IPTp. Therefore, IPT2/ANC1 is a metric of the quality of ANC care that differs somewhat from ANC4+/ANC1.

Skilled birth attendance (SBA) is a major health goal in Uganda and throughout LMICs. The 5th Millennium Development Goal, which sought to reduce maternal mortality by 75%, was directly tied to increasing SBA (141). In Uganda, facility deliveries are the primary platform for SBA. Therefore, I have included facility deliveries as a non-HIV indicator. However, as women may deliver at a facility other than the one in which they receive ANC, the ratio of facility deliveries to ANC1 would not proxy coverage of facility delivery among pregnant women, and we did not include it as an indicator.

Lastly, as a postnatal and child health metric, I have included the number of Diphtheria-Pertussis-Tetanus (DPT) or pentavalent (Diphtheria-Pertussis-Tetanus, HiB, Hepatitis B) 3rd doses received. Moreover, several previous studies of the effects of HIV programs on non-HIV health care have included immunization as an outcome (57, 58, 67). Uganda adopted pentavalent immunization in 2002 (142), but adapted its reporting forms to include only pentavalent in July 2015. Therefore, I include immunization with either DPT or pentavalent 3rd dose. Since three doses must be administered within the first year, usually in a health facility, DPT3/penta3 indicates a sustained relationship between mothers and facilities in the postnatal period and a regular supply of vaccine. Oral polio vaccine and measles, mumps, & rubella (MMR) vaccines are provided outside of health facilities through specialized immunization events. Therefore, their provision might not reflect health facility capacity. Furthermore, as women do not necessarily seek ANC and immunizations for their infants from the same facilities, we cannot estimate immunization rates at the level of the facility using ANC as a denominator.

In addition to the outcomes presented in Table 17, I sought to calculate data related to Early Infant Diagnosis (EID), which is a measure of PMTCT success or early identification. However, the rarity of reporting on EID and the substantial lag between reporting of births of exposed infants and follow-up testing, hinder easy interpretation. Two outcomes related to quality of antenatal care (ANC), syphilis & HIV testing in ANC, could not be obtained from Uganda's reporting forms.

6.3.2 DHIS2 Model Specification:

<u>Basic Count Trend Model:</u>

$$log\left(E(y_{it}|Z_j,u_j,t)\right) = u_j + \beta_0 + \beta_L \times L_j + \beta_O \times O_j + \beta_1 \times t + \beta_2 \times t \times T_i + \beta_3 \times P_t \times (t - t_0) + \beta_4 \times P_t \times (t - t_0) \times T_i \quad \textbf{(Eq. 1)}$$

Where,

$y_{it}|\zeta_j \sim Poisson(\zeta_{ij})$

$\zeta_{ij}|u_j \sim Gamma(r,p)$

$u_j \sim N(0,\tau^2)$

Equation 1 presents the negative binomial random intercept trend model used for count data. The outcome, y_{it}, is a count of services or events, where i denotes group membership (0=maintenance, 1=transition), and t is a time unit index (months or quarters). Each facility, denoted by j has a random intercept u_j, and fixed covariates for level, L_j, and ownership, O_j. The purpose of the fixed characteristics is to improve the validity of the assumption of normally distributed random intercepts by accounting for major systematic differences in utilization by facilities due to level and ownership. The dummies P_t and T_i, represent post-transition and transition facility, respectively. There are terms for the maintenance pre-transition trend, β_1, the difference in slope for transition facilities prior to transition, β_2, a change in slope for maintenance facilities, β_3, following the transition midpoint, t_0, and a difference-in-difference in trend, β_4. I infer the transition impact from the statistical evaluation of the difference-in-difference in trend. The random intercepts are modeled as normally distributed. Since y_{it} is modeled as negative binomial, it is distributed as a Poisson with a random rate, ζ_j, that is a draw from a gamma-distribution for each facility. In the sensitivity analysis, I vary the transition midpoint, t_0, and also replace the assumption of negative binomial distribution in calculation of standard errors and derive a confidence interval using a bootstrap method.

Basic Proportions Model:

$$E(y_{it}|Z_j, u_j) = u_j + \beta_0 + \beta_L \times L_j + \beta_O \times O_j + \beta_1 + \beta_2 \times T_i + \beta_3 \times P_t + \beta_4 \times P_t \times T_i$$

(Eq. 2)

Where,
$u_j \sim N(0, \tau^2)$

Equation 2 presents a difference-in-difference model for proportion outcomes, y_{it}, that are presumed to be normally distributed. The primary difference in these models compared to the count models are that the coefficients $\beta_1, \dots, \beta_4$ represent relative differences in proportions rather than relative slopes in the trend line. For example, β_1, represents the level for maintenance in the pre period, β_2 the difference for transition, β_3 , the difference for maintenance post vs. pre-transition, and β_4 the difference-in-difference. In the sensitivity analysis, I vary the pre and post periods around a "transition window." I also replace the assumption of normally-distributed outcomes using a bootstrap to generate an empirical confidence interval.

6.3.3 DHIS2 Data Cleaning:

I excluded observations that were multiple times higher than the facility-specific average value. For example, for HTC, I excluded values that were greater than 10 times the mean for any facility that had a minimum of 20 tests per month on average (Table 44) I deemed counts smaller than the minimum to be too variable to use this method, and unlikely to contribute substantially to errors. I also checked the largest 1-5% of cases to look for improbably high values given the facility size. For HTC, I removed any values from analysis with more than 10,000 reported HTC in a month, which exceeds the level of even the most active facilities. Less than 0.1% of cases were excluded for most indicators; however, for cohort retention in Uganda I excluded 11.4% of cases for quality issues. Changes to Uganda's reporting forms in July 2015 meant that cohort retention went from being reported as a numerator and denominator to reporting a quotient as a percentage, which resulted in data quality issues. Any record with <1% or >100% cohort retention was excluded from the analysis.

Table 44: Key Parameters and Results of Data Cleaning - DHIS2

Indicator	Cutoff (x Mean)	Minimum	N Obs. Flagged	N Obs. in Model	Percent Flagged
OPD (new, repeat visit)	10, 15	50, 30	40	48,984	0.08%
IPT2	10	0	5	19,651	0.03%
ANC Total	8	20	7	49,192	0.01%
ANC4	5	100	9	19,717	0.05%
Facility Delivery	10	5	13	46,144	0.03%
HTC	10	20	29	49,187	0.06%
DPT3	10	10	5	49,195	0.01%
Current on ART (old, new)	5,4	5	4	7,858	0.05%
New on ART	5	5	19	7,591	0.25%
Cohort Retention	N/A	N/A	711	5,529	11.4%

6.3.4 DHIS2 Full Model Results: Full Sample (ITT)

Table 45: Full DHIS2 Base Models (Count Indicators, Trend Analysis)

	HIV Indicators			Non-HIV Indicators			
	HTC	New on ART	Current on ART	OPD	ANC Total	Facility Deliveries	DPT3
	IIR (95% C.I) p-value	*IIR (95% C.I) p-value*	*IIR (95% C.I) p-value*	*IIR (95% C.I) p-value*	*IIR (95% C.I) p-value*	*IIR (95% C.I) p-value*	*IIR (95% C.I) p-value*
Level							
HC III vs. HC II	**11.668*** (9.369,14.53) <0.001**	**1.574* (1.072, 2.310) 0.021**	**2.145*** (1.397, 3.291) <0.001**	**1.620*** (1.507, 1.742) <0.001**	**6.958*** (5.510,8.787) <0.001**	**19.240*** (14.06,26.33) <0.001**	**2.175*** (1.854,2.552) <0.001**
HC IV vs. HC II	**28.046*** (20.64,38.11) <0.001**	**4.749*** (3.084, 7.313) <0.001**	**12.379*** (7.645, 20.05) <0.001**	**2.824*** (2.580, 3.092) <0.001**	**15.305*** (11.82,19.82) <0.001**	**56.195*** (38.37,82.30) <0.001**	**3.519*** (2.913,4.252) <0.001**
Hospital vs. HC II	**23.548*** (12.46,44.49) <0.001**	**8.177*** (5.130, 13.03) <0.001**	**26.120*** (14.90, 45.80) <0.001**	**6.206*** (4.617, 8.341) <0.001**	**25.180*** (17.90,35.42) <0.001**	**123.57*** (81.99,186.2) <0.001**	**7.689*** (5.458,10.83) <0.001**
Ownership							
PNFP vs. Public	**2.290** (1.429,3.670) 0.001**	0.908 (0.350, 2.354) 0.842	**0.922*** (0.331, 2.565) <0.001**	**0.386*** (0.306, 0.487) <0.001**	**0.087*** (0.043,0.176) <0.001**	**0.367* (0.162,0.833) 0.017**	**0.030*** (0.014,0.067) <0.001**
PFP vs. Public	1.164 (0.938,1.444) 0.168	**0.629*** (0.510, 0.777) <0.001**	**0.553*** (0.417, 0.733) <0.001**	**0.331*** (0.294, 0.373) <0.001**	**0.492*** (0.370,0.654) <0.001**	0.789 (0.569,1.093) 0.154	**0.638*** (0.506,0.804) <0.001**
Pre-Transition Maintenance Trend	**1.003** (1.001,1.006) 0.005**	**0.980*** (0.974, 0.987) <0.001**	**1.083*** (1.076, 1.090) <0.001**	1.000 (0.999, 1.002) 0.629	**1.003*** (1.002,1.004) <0.001**	**1.008*** (1.007,1.010) <0.001**	0.999 (0.998,1.001) 0.407
Post-Trans Maintenance Trend	0.994 (0.986,1.003) 0.186	**1.093*** (1.074, 1.112) <0.001**	**0.974*** (0.962, 0.986) <0.001**	**0.993** (0.989, 0.997) 0.001**	0.998 (0.993,1.002) 0.267	0.996 (0.990,1.001) 0.119	**0.994** (0.990,0.998) 0.002**
Pre-Trans Transition Trend	**0.989*** (0.985,0.994) <0.001**	**0.964*** (0.950, 0.978) <0.001**	0.999 (0.985, 1.013) 0.914	1.000 (0.998, 1.002) 0.629	1.000 (0.997,1.003) 0.934	1.000 (0.997,1.003) 0.768	1.000 (0.998,1.002) 0.929
Post x Transition Trend	**1.031*** (1.016,1.047) <0.001**	**1.064* (1.013, 1.116) 0.012**	1.012 (0.976, 1.050) 0.518	1.001 (0.995, 1.006) 0.843	1.008 (0.999,1.016) 0.072	1.008 (0.998,1.018) 0.121	1.002 (0.996,1.009) 0.496
Seasonality							
February	**1.057* (1.008,1.109) 0.023**			**0.927*** (0.908, 0.946) <0.001**	**0.915*** (0.886,0.944) <0.001**	**0.937*** (0.918,0.956) <0.001**	0.981 (0.959,1.003) 0.092
March	**1.319*** (1.237,1.406) <0.001**			**1.035*** (1.018, 1.053) <0.001**	1.011 (0.970,1.053) 0.614	1.002 (0.981,1.023) 0.841	**1.026* (1.003,1.050) 0.024**
April	**1.184*** (1.113,1.259) <0.001**			**1.033** (1.014, 1.052) 0.001**	**0.958** (0.927,0.989) 0.009**	0.979 (0.958,1.000) 0.054	**1.045** (1.018,1.072) 0.001**
May	**1.290*** (1.220,1.363) <0.001**			**1.250*** (1.227, 1.274) <0.001**	1.006 (0.974,1.040) 0.705	**1.028* (1.004,1.053) 0.022**	1.011 (0.988,1.036) 0.352
June	**1.305*** (1.232,1.382) <0.001**			**1.339*** (1.313, 1.365) <0.001**	1.015 (0.981,1.052) 0.391	0.989 (0.965,1.014) 0.383	0.999 (0.973,1.025) 0.917
July	**1.301*** (1.220,1.387) <0.001**			**1.195*** (1.172, 1.219) <0.001**	1.007 (0.972,1.044) 0.693	0.985 (0.962,1.010) 0.236	**1.050*** (1.024,1.077) <0.001**
August	**1.320*** (1.251,1.394) <0.001**			**1.119*** (1.095, 1.143) <0.001**	1.015 (0.982,1.049) 0.377	**1.051*** (1.026,1.077) <0.001**	**1.050*** (1.023,1.078) <0.001**

September	**1.364*** (1.282,1.452) <0.001**			**1.055*** (1.032, 1.078) <0.001**	**0.962* (0.930,0.995) 0.024**	**1.145*** (1.107,1.184) <0.001**	1.013 (0.988,1.039) 0.308
October	**1.276*** (1.214,1.342) <0.001**			**1.178*** (1.154, 1.203) <0.001**	0.980 (0.948,1.012) 0.220	**1.059*** (1.036,1.083) <0.001**	**1.100*** (1.074,1.128) <0.001**
November	**1.305*** (1.236,1.378) <0.001**			**1.139*** (1.118, 1.160) <0.001**	**0.936*** (0.905,0.968) <0.001**	0.988 (0.966,1.011) 0.308	**1.029* (1.002,1.056) 0.034**
December	**1.099*** (1.044,1.157) <0.001**			**1.030*** (1.013, 1.046) <0.001**	**0.833*** (0.806,0.861) <0.001**	0.984 (0.956,1.013) 0.268	**0.934*** (0.912,0.956) <0.001**
Constant	**13.029*** (10.37,16.38) <0.001**	**6.508*** (4.495, 9.422) <0.001**	**18.39*** (12.14, 27.86) <0.001**	**571.0*** (541.5, 602.2) <0.001**	**14.62*** (11.77,18.16) <0.001**	0.736 (0.539,1.006) 0.054	**17.10*** (15.09,19.38) <0.001**
N facilities	989	482	482	989	989	926	989
N obs.	49,187	7,591	7,858	48,984	49,192	46,144	49,195

*p<0.05, **p<0.01, ***p<0.001

Table 46: Full DHIS2 Base Models (Proportion Indicators, D-in-D Analysis)

	Cohort Retention	ANC4+ Coverage	IPT2 Coverage
	Proportion (95% C.I.) p-value	*Proportion (95% C.I.) p-value*	*Proportion (95% C.I.) p-value*
Level			
HC III vs. HC II	0.011 (-0.039, 0.06) 0.676	-0.016 (-0.053,0.022) 0.423	-0.007 (-0.017,0.003) 0.185
HC IV vs. HC II	-0.037 (-0.094, 0.021) 0.210	-0.024 (-0.079,0.030) 0.386	-0.014 (-0.031,0.002) 0.093
Hospital vs. HC II	0.010 (-0.053, 0.073) 0.759	-0.002 (-0.069,0.065) 0.944	**-0.030*** **(-0.053,-0.007)** **0.010**
Ownership			
PNFP vs. Public	-0.019 (-0.052, 0.015) 0.278	**0.188***** **(0.075,0.301)** **<0.001**	-0.019 (-0.054,0.015) 0.265
PFP vs. Public		**0.055*** **(0.007,0.104)** **0.024**	**-0.021**** **(-0.033,-0.009)** **0.001**
Transition	0.011 (-0.030, 0.052) 0.592	**0.044*** **(0.006,0.083)** **0.023**	0.001 (-0.010,0.012) 0.854
Post vs. Pre	**-0.088***** **(-0.108, -0.068)** **<0.001**	**0.066***** **(0.043,0.089)** **<0.001**	**0.024***** **(0.015,0.034)** **<0.001**
Post x Transition	-0.042 (-0.096, 0.013) 0.132	**-0.043*** **(-0.082,-0.004)** **0.031**	-0.008 (-0.025,0.008) 0.302
Seasonality			
February		**0.111*** **(0.014,0.209)** **0.025**	**0.018*** **(0.004,0.033)** **0.014**
March		**0.088***** **(0.049,0.128)** **<0.001**	0.013 (-0.003,0.029) 0.108
April		**0.082***** **(0.050,0.115)** **<0.001**	0.001 (-0.013,0.014) 0.910
May		**0.036*** **(0.003,0.068)** **0.033**	-0.006 (-0.019,0.007) 0.381
June		**0.038*** **(0.006,0.070)** **0.021**	0.010 (-0.003,0.024) 0.144
July		**0.058***** **(0.027,0.090)** **<0.001**	**0.015*** **(0.002,0.029)** **0.023**
August		**0.131***** **(0.098,0.164)** **<0.001**	0.006 (-0.008,0.020) 0.375
September		**0.134***** **(0.101,0.167)** **<0.001**	0.000 (-0.014,0.013) 0.979
October		**0.093***** **(0.063,0.122)** **<0.001**	0.008 (-0.005,0.021) 0.220
November		**0.097***** **(0.068,0.126)** **<0.001**	0.007 (-0.006,0.020) 0.283
December		**0.121***** **(0.090,0.152)** **<0.001**	**0.016*** **(0.003,0.029)** **0.019**
Constant	**0.812***** **(0.763, 0.862)** **<0.001**	**0.324***** **(0.278,0.371)** **<0.001**	**0.256***** **(0.240,0.272)** **<0.001**
N facilities	465	938	939
N observations	2,277	19,717	19,651

6.3.5 Sensitivity Analysis Tables: Effect Measure Modification

Table 47: Effect Measure Modification by Region (Trend Analysis)

Indicator	Diff-in-Diff:	All	Central	Eastern	Northern	Western
HTC	*IRR*	**1.031*****	1.003	1.003	**1.040****	1.038
	Robust 95% C.I.	**(1.016, 1.047)**	(0.972, 1.035)	(0.978, 1.029)	**(1.016, 1.066)**	(0.995, 1.083)
	p-value	**<0.001**	0.857	0.819	**0.001**	0.080
New on ART	*IRR*	**1.064***	0.976	0.975	**1.117****	**1.149***
	Robust 95% C.I.	**(1.013,1.116]**	(0.893, 1.066)	(0.927, 1.025)	**(1.028, 1.215)**	**(1.016, 1.298)**
	p-value	**0.012**	0.586	0.318	**0.009**	**0.027**
Current on ART	*IRR*	1.012	1.008	1.000	1.033	1.000
	Robust 95% C.I.	[0.976,1.050]	(0.959, 1.060)	(0.954, 1.049)	(0.973, 1.098)	(0.929, 1.076)
	p-value	0.518	0.754	0.984	0.286	0.995
OPD	*IRR*	1.001	0.990	0.998	1.004	0.994
	Robust 95% C.I.	(0.995, 1.006)	(0.974, 1.007)	(0.988, 1.009)	(0.995, 1.014)	(0.984, 1.004)
	p-value	0.843	0.243	0.767	0.375	0.258
Total ANC Visits	*IRR*	1.008	1.005	1.002	1.004	1.022
	Robust 95% C.I.	(0.999, 1.016)	(0.987, 1.023)	(0.989, 1.015)	(0.990, 1.019)	(0.997, 1.047)
	p-value	0.072	0.624	0.764	0.556	0.079
Facility Delivery	*IRR*	1.008	1.018	1.011	1.007	1.002
	Robust 95% C.I.	(0.997, 1.018)	(0.993, 1.043)	(0.995, 1.028)	(0.991, 1.022)	(0.966, 1.040)
	p-value	0.121	0.152	0.175	0.392	0.901
DPT3 #	*IRR*	1.002	1.008	0.995	1.001	1.008
	Robust 95% C.I.	(0.995, 1.009)	(0.992, 1.024)	(0.981, 1.009)	(0.990, 1.012)	(0.995, 1.021)
	p-value	0.496	0.339	0.482	0.885	0.237

 # Restricted to facilities with a mean of >5 immunizations per month to improve convergence
*p<0.05, **p<0.01, ***p<0.001

Table 48: Effect Measure Modification by Region (D-in-D Analysis)

Indicator	D-in-D	Preferred Model	Central	Eastern	Northern	Western
ANC4+ Coverage	*IRR*	**-0.043***	-0.072	-0.016	0.015	-0.054
	Robust 95% C.I.	**(-0.082, -0.004)**	(-0.170, 0.026)	(-0.077, 0.045)	(-0.045, 0.074)	(-0.158, 0.050)
	p-value	**0.031**	0.151	0.612	0.622	0.310
IPT2 Coverage	*IRR*	-0.008	0.002	0.008	-0.019	0.001
	Robust 95% C.I.	(-0.025, 0.008)	(-0.030, 0.035)	(-0.024, 0.041)	(-0.045, 0.006)	(-0.039, 0.040)
	p-value	0.302	0.894	0.612	0.142	0.975
Cohort Retention	*IRR*	-0.043	**-0.112***	-0.073	0.011	**-0.175***
	Robust 95% C.I.	(-0.096, 0.012)	**(-0.218, -0.006)**	(-0.151, 0.006)	(-0.065, 0.087)	**(-0.347, -0.004)**
	p-value	0.132	**0.039**	0.069	0.776	**0.045**

*p<0.05, **p<0.01, ***p<0.001

Table 49: Effect Measure Modification by Facility Level (Trend Analysis)

Indicator	Diff-in-Diff:	All	HC II	HC III	HC IV & Hospital
HTC	*IRR*	**1.031*** **	1.016	1.016	0.982
	Robust 95% C.I.	**(1.016, 1.047)**	(0.981, 1.053)	(0.999, 1.034)	(0.942, 1.025)
	p-value	**<0.001**	0.375	0.065	0.413
	N	989	470	428	91
Current on ART	*IRR*	1.009	Excluded	1.009	1.003
	Robust 95% C.I.	(0.989, 1.029)		(0.968, 1.052)	(0.939, 1.070)
	p-value	0.379		0.671	0.939
	N	482		360	86
New on ART	*IRR*	**1.062***	Excluded	**1.080****	0.993
	Robust 95% C.I.	**(1.031, 1.094)**		**(1.019, 1.145)**	(0.914, 1.078)
	p-value	**<0.001**		**0.009**	0.859
	N	**482**		**360**	86
OPD	*IRR*	1.001	1.002	1.008	1.017
	Robust 95% C.I.	(0.995, 1.006)	(0.990, 1.014)	(0.998, 1.018)	(0.995, 1.039)
	p-value	0.843	0.707	0.107	0.134
	N	989	470	428	91
Total ANC Visits #	*IRR*	1.008	1.004	1.007	1.018
	Robust 95% C.I.	(0.999, 1.016)	(0.984, 1.025)	(0.997, 1.017)	(0.999, 1.038)
	p-value	0.072	0.703	0.196	0.066
	N	962	470	428	91
Facility Delivery	*IRR*	1.008	1.008	1.007	0.999
	Robust 95% C.I.	(0.997, 1.018)	(0.976, 1.041)	(0.995, 1.019)	(0.982, 1.016)
	p-value	0.121	0.630	0.229	0.881
	N	926	415	420	91
DPT3	*IRR*	1.002	1.010	1.006	1.005
	Robust 95% C.I.	(0.995, 1.008)	(0.997, 1.023)	(0.995,1.017)	(0.985, 1.025)
	p-value	0.627	0.116	0.262	0.618
	N	989	446	423	90

*p<0.05, **p<0.01, ***p<0.001

Table 50: Effect Measure Modification by Level for (D-in-D Analysis)

Indicator	Diff-in-Diff:	All	HC II	HC III	HC IV & Hospital
ANC4+ Coverage	*IRR*	**-0.043***	**-0.095***	0.003	-0.005
	Robust 95% C.I.	**(-0.082, -0.004)**	**(-0.181, -0.009)**	(-0.054, 0.059)	(-0.073, 0.064)
	p-value	**0.031**	**0.030**	0.926	0.889
	N	**938**	**425**	422	91
IPT2 Coverage	*IRR*	-0.008	-0.026	0.009	-0.005
	Robust 95% C.I.	(-0.025, 0.008)	(-0.060, 0.009)	(-0.012, 0.030)	(-0.041, 0.031)
	p-value	0.302	0.142	0.406	0.775
	N[1]	939	425	422	91
Cohort Retention	*IRR*	-0.043	Excluded	-0.032	-0.086
	Robust 95% C.I.	(-0.096, 0.012)		(-0.088, 0.025)	(-0.235, 0.063)
	p-value	0.132		0.270	0.258
	N	465		354	84

[1]N may not sum across categories due to missing information on facility level for a small number of facilities.
*p<0.05, **p<0.01, ***p<0.001

Table 51: Effect Measure Modification by Ownership (Trend Analysis)

Indicator	D-in-D	All	Public	PNFP	PFP
HTC	*IRR*	**1.031*** **	**1.027** **	**1.031***	1.007
	Robust 95% C.I.	**(1.016, 1.047)**	**(1.008, 1.046)**	**(1.000, 1.063)**	(0.931, 1.088)
	p-value	**<0.001**	**0.005**	**0.048**	0.869
	N	**989**	**734**	**188**	67
Current on ART	*IRR*	1.009	1.022	0.961	N/A
	Robust 95% C.I.	(0.989, 1.029)	(0.980, 1.066)	(0.905, 1.020)	
	p-value	0.379	0.315	0.190	
	N	482	400	79	
New on ART	*IRR*	**1.062***	**1.081** **	0.967	N/A
	Robust 95% C.I.	**(1.031, 1.094)**	**(1.024, 1.142)**	(0.885, 1.058)	
	p-value	**<0.001**	**0.005**	0.467	
	N	**482**	**400**	79	
OPD	*IRR*	1.001	0.998	1.006	0.998
	Robust 95% C.I.	(0.995, 1.006)	(0.992, 1.004)	(0.989, 1.023)	(0.918, 1.084)
	p-value	0.843	0.465	0.519	0.957
	N	989	734	188	67
Total ANC Visits	*IRR*	1.008	1.004	1.002	0.995
	Robust 95% C.I.	(0.999, 1.016)	(0.996, 1.012)	(0.983, 1.021)	(0.870, 1.139)
	p-value	0.072	0.349	0.875	0.945
	N	989	734	188	67
Facility Delivery	*IRR*	1.008	1.007	0.994	1.016
	Robust 95% C.I.	(0.997, 1.018)	(0.996, 1.018)	(0.974, 1.015)	(0.936, 1.104)
	p-value	0.121	0.201	0.576	0.701
	N	926	687	181	58
DPT3	*IRR*	1.002	1.007	0.993	^
	Robust 95% C.I.	(0.995, 1.008)	(1.000, 1.014)	(0.977, 1.009)	
	p-value	0.627	0.063	0.397	
	N	990	719	180	

N/A – Not Applicable
^ *Model could not be fit*
*p<0.05, **p<0.01, ***p<0.001

Table 52: Effect Measure Modification by Ownership (D-in-D Analysis)

Indicator	D-in-D:	All	Public	PNFP	PFP
ANC4+ Coverage	*Est.*	**-0.043***	-0.027	-0.047	-0.201
	Robust 95% C.I.	**(-0.082, -0.004)**	(-0.066, 0.012)	(-0.164, 0.069)	(-0.424, 0.022)
	p-value	**0.031**	0.177	0.427	0.077
	N	**938**	708	175	55
IPT2 Coverage	*Est.*	-0.008	**-0.019***	0.029	0.016
	Robust 95% C.I.	(-0.025, 0.008)	**(-0.036, -0.001)**	(-0.012, 0.071)	(-0.071, 0.103)
	p-value	0.302	**0.035**	0.169	0.716
	N	939	**709**	178	52
Cohort Retention	*Est.*	-0.043	-0.044	-0.028	N/A
	Robust 95% C.I.	(-0.096, 0.012)	(-0.105, 0.016)	(-0.147, 0.092)	
	p-value	0.132	0.149	0.649	
	N	465	389	76	

*p<0.05, **p<0.01, ***p<0.001

6.3.6 Full Table for Cohort Retention (Full ITT Sample & Survey-only Sample)

Table 53: Models for Cohort Retention (Full & Facility Survey Sample)

Cohort Retention	Full Sample	Survey Sample	
	Robust S.E.	**Robust S.E.**	**Bootstrap S.E.**
	Prop.* *(95% C.I.)* *p-value	***Prop.* *(95% C.I.)* *p-value***	***Prop.* *(95% C.I.)* *p-value***
Level			
HC III vs. HC II	0.011 (-0.039, 0.06) 0.676	0.101 (0, 0.202) 0.050	0.101 (-0.028, 0.23) 0.126
HC IV vs. HC II	-0.037 (-0.094, 0.021) 0.210	0.019 (-0.092, 0.13) 0.739	0.019 (-0.117, 0.155) 0.784
Hospital vs. HC II	0.010 (-0.053, 0.073) 0.759	**0.118*** **(0.002, 0.234)** **0.047**	0.118 (-0.028, 0.264) 0.114
Owner			
PNFP vs. Public	-0.019 (-0.052, 0.015) 0.278	**0.081**** **(0.024, 0.138)** **0.005**	**0.081*** **(0.018, 0.144)** **0.011**
Transition vs. Maintenance	0.009 (-0.019, 0.037) 0.537	0.071 (-0.037, 0.178) 0.198	0.071 (-0.049, 0.19) 0.245
Post vs. Pre	**-0.088***** **(-0.108, -0.068)** **<0.001**	-0.037 (-0.139, 0.066) 0.481	-0.037 (-0.148, 0.075) 0.518
Post x Transition	-0.042 (-0.096, 0.013) 0.132	-0.104 (-0.214, 0.006) 0.063	-0.104 (-0.222, 0.013) 0.082
Constant	**0.812***** **(0.763, 0.862)** **<0.001**	**0.680***** **(0.558, 0.802)** **<0.001**	**0.680***** **(0.534, 0.825)** **<0.001**
N Obs	5,529	636	636
N Facilties	465	133	133
N Transition	116	123	123
N Maintenance	349	10	10

*p<0.05, **p<0.01, ***p<0.001

6.4 *Annex: Paper 3*

6.4.1 Data Cleaning

In July 2015, Uganda changed its system for HIV cohort data from reporting a numerator and denominator separately to reporting a quotient out of 100 (e.g. 88%). Some facilities switched before and some later than the official date, and the result was that some facilities had retention <1%. Other facilities report more than 100% retention, likely due to tabulation errors. I have flagged any reports that have <1% or >100% cohort retention. I report the proportion of data flagged for each outcome in Table 33B.

6.4.2 Paper 3 – Additional Tables & Figures

Table 54: Weighted, Unadjusted Proportion of Public, PNFP, and PFP Facilities Reporting Selected Outcomes (Facility Survey)

	Weighted Proportion Reporting Outcome % (95% C.I.) with Weighted Chi-Square Test p-values					Weighted Chi-Sq. Test
Outcome	**PNFP**	**PNFP vs. Public p-value**	**Public**	**Public vs. PFP p-value**	**PFP**	**Public vs. PNFP vs. PFP p-value**
Decline in HIV Supervision Frequency	**61.5% (46.9, 74.3)**	**0.026**	**43.9% (38.3, 49.7)**	**0.002**	**18.0% (9.6, 31.2)**	**<0.001**
Discontinued Outreach	46.8% (30.7, 63.7)	0.546	52.0% (44.4, 59.5)	0.797	54.2% (37.6, 70.0)	0.769
Workers Report Less Time on HIV Services	33.8% (23.1, 46.5)	0.082	**23.5% (18.6, 29.2)**	**<0.001**	**59.6% (42.7, 74.4)**	**<0.001**
Workers Report Less Time on Non-HIV Services	13.5% (6.8, 25.2)	0.648	11.5% (8.5, 15.4)	0.072	20.8% (11.7, 34.3)	0.155
Workers Report Less Time on Training	35.7% (25.3, 47.6)	0.545	39.2% (33.5, 45.3)	0.667	42.3% (28.7, 57.1)	0.709
IP providing supervision after transition	3.4% (1.0, 11.1)	0.056	10.9% (8.0, 14.7)	0.494	14.3% (6.6, 28.1)	0.153
In-charge Reports Less Time on HIV and More Time on MNCH	12.6% (7.3, 21.1)	0.056	21.0% (17.8, 24.7)	0.733	23.5% (12.0, 40.9)	0.319
Increased Disruption of Viral Load Testing	**8.8% (3.6, 19.9)**	**0.016**	**24.3% (19.3, 30.0)**		omitted	
Increased Disruption of Sputum Testing	13.0% (5.4, 27.9)	0.068	27.4% (22.6, 32.9)	0.078	7.6% (1.4, 32.8)	0.058
Post-hoc Outcomes						
In-charge Reports Loss of Staff as a Result of Transition	12.6% (7.3, 21.1)	0.056	21.0% (17.8, 24.7)			
In-charge Reports HIV Service Quality has Declined	**21.4% (14.1, 31.1)**	**<0.001**	**41.6% (36.3, 47.1)**			

Table 55: Non-significant Findings for Facility Survey Outcomes

Hypothesis Type	***Pre-Specified***	***Pre-Specified***	***Pre-Specified***	***Pre-Specified***
Model	***Logistic***	***Logistic***	***Logistic***	***(Bootstrap S.E.)***
Outcome	**IP providing supervision after transition**	**In-charge Reports Less Time on HIV and More Time on MNCH**	**Increased Disruption of Viral Load Testing**	**Annualized HIV Training Days per Worker since Transition**
	OR (95% C.I.) p-value	**OR (95% C.I.) p-value**	**OR (95% C.I.) p-value**	**Days (95% C.I.) p-value**
Ownership:				
PNFP vs. Government	0.304 (0.070, 1.331) 0.109	0.592 (0.311, 1.128) 0.106	1.038 (0.371, 2.902) 0.941	2.762 (-1.361, 6.885) 0.189
PFP vs. Government	1.155 (0.483, 2.761) 0.735	1.036 (0.372, 2.886) 0.944	N/A[2]	-0.258 (-1.190, 0.674) 0.586
Level:				
HC III vs. HC II		0.494 (0.218, 1.122) 0.088		**1.498* (0.134, 2.862) 0.031**
HC IV/Hospital vs. HC II	Omitted[1]	0.620 (0.156, 2.465) 0.481		3.532 (-0.033, 7.098) 0.052
IV/Hospital vs. HC II/HC III			0.930 (0.107, 8.069) 0.945	
Transition Impact Index	**0.612** (0.428, 0.876) 0.009**	1.342 (0.970, 1.858) 0.074	**1.578* (1.055, 2.361) 0.028**	-0.382 (-1.158, 0.384) 0.335
Preparedness Index	**0.514** (0.318, 0.833) 0.009**	0.732 (0.484, 1.108) 0.133	0.578 (0.324, 1.030) 0.062	0.508 (-0.601, 1.618) 0.369
Time since Transition	1.000 (0.970, 1.030) 0.989	1.007 (0.976, 1.040) 0.637	1.000 (0.948, 1.055) 0.998	0.037 (-0.011, 0.085) 0.127
Number of HIV Workers Prior to Transition	1.103 (0.993, 1.225) 0.065	0.954 (0.849, 1.073) 0.419	**1.120** (1.056, 1.187) 0.001**	0.047 (-0.153, 0.247) 0.644
Central Support District	1.128 (0.616, 2.066) 0.683	1.397 (0.999, 1.952) 0.051	**2.165* (1.103, 4.248) 0.027**	-0.715 (-1.991, 0.560) 0.272
New District	1.303 (0.652, 2.608) 0.437	0.619 (0.346, 1.108) 0.102	**0.608* (0.412, 0.896) 0.014**	-0.051 (-1.115, 1.044) 0.927
Constant	1.827 (0.243, 13.71) 0.542	0.821 (0.123, 5.508) 0.833	0.241 (0.010, 5.633) 0.358	-0.265 (-4.872, 4.342) 0.913
N	**206**	**191**	**151**	**206**

*Notes: *p<0.05, **p<0.01, ***p<0.001.*

[1]The level HC IV/Hospital is a perfect predictor of not having IP involvement following transition. Therefore, I removed level from the analysis rather than lose the cases.

[2]There were no very few PFPs in our facility survey sample that provided VL testing. Excluded from analysis.

Table 56: Sensitivity Analysis for HTC in PFPs

	Preferred Model (Jan 2015 – March 2017)	Early Transition Period (Oct 2014 – Dec 2016)	Late Transition Period (July 2015 – Mar 2017)	Preferred Model (Excluding Oct 2013– Jan 2014)
Standard Error	**Robust S.E.**	**Robust S.E.**	**Robust S.E.**	**Robust S.E.**
	IRR* *(95% C.I.)* *p-value	***IRR* *(95% C.I.)* *p-value***	***IRR* *(95% C.I.)* *p-value***	***IRR* *(95% C.I.)* *p-value***
Ownership				
PFP vs. Government	**2.817*** (1.702, 4.664) <0.001**	**3.084*** (1.824, 5.217) <0.001**	**2.468*** (1.505, 4.046) <0.001**	**2.466*** (1.514, 4.014) <0.001**
Post	1.145 (0.970, 1.353) 0.111	1.053 (0.894, 1.240) 0.539	1.138 (0.977, 1.326) 0.096	0.979 (0.834, 1.150) 0.800
PFP x Post	**0.621* (0.426, 0.903) 0.013**	**0.566** (0.378, 0.848) 0.006**	**0.698* (0.494, 0.986) 0.042**	**0.679* (0.482, 0.957) 0.027**
Level: *HC IV & Hospital (vs. HC II & III)*	**6.807** (2.113, 21.93) 0.001**	**6.726** (2.093, 21.62) 0.001**	**7.171** (2.214, 23.23) 0.001**	**7.241** (2.316, 22.64) 0.001**
Constant	**20.50*** (15.81, 26.59) <0.001**	**20.19*** (15.53, 26.23) <0.001**	**21.05*** (16.34, 27.13) <0.001**	**22.42*** (17.30, 29.04) <0.001**
N obs.:	**10,319**	**10,343**	**13,421**	**8,657**
N facilities:	**454**	**454**	**454**	**454**
Public	*400*	*400*	*400*	*400*
PFP	*54*	*54*	*54*	*54*

*Notes: *p<0.05, **p<0.01, ***p<0.001.*

Table 57: Sensitivity Analysis for HTC in PNFPs

PNFP vs. Government	**Preferred Model (Jan 2015 – March 2017)**	**Early Transition Period (Oct 2014 – Dec 2016)**	**Late Transition Period (July 2015 – Mar 2017)**
	Robust S.E.	**Robust S.E.**	**Robust S.E.**
	IRR (95% C.I.) p-value	**IRR (95% C.I.) p-value**	**IRR (95% C.I.) p-value**
Ownership			
PNFP vs. Government	**1.707** (1.164, 2.505) 0.006**	**1.726** (1.149, 2.594) 0.009**	**1.646** (1.134, 2.391) 0.009**
Post	1.145 (0.970, 1.351) 0.110	1.053 (0.895, 1.240) 0.534	1.138 (0.978, 1.325) 0.096
PNFP x Post	1.100 (0.816, 1.484) 0.532	1.132 (0.838, 1.530) 0.419	1.117 (0.850, 1.467) 0.428
Level: *HC IV & Hospital (vs. HC II & III)*	**13.01*** (7.270, 23.29) <0.001**	**13.34*** (7.451, 23.88) <0.001**	**13.72*** (7.905, 23.80) <0.001**
Constant	**20.14*** (15.61, 26.00) <0.001**	**19.78*** (15.29, 25.60) <0.001**	**20.66*** (16.11, 26.50) <0.001**
N obs.:	**11,902**	**11,919**	**15,424**
N facilities:	**513**	**513**	**513**
Public	396	396	396
PNFP	117	117	117

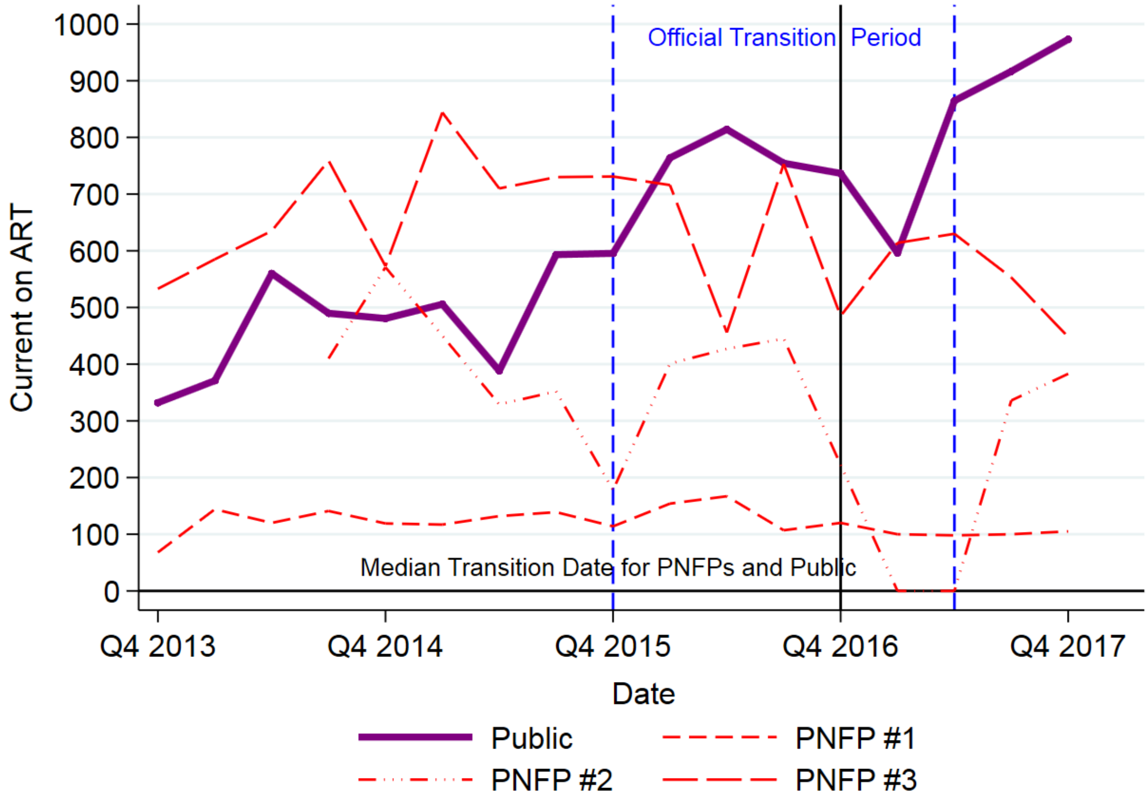
*Notes: *p<0.05, **p<0.01, ***p<0.001.*

Table 58: Sensitivity Analysis for Cohort Retention

	Preferred Model (Jan 2015 – Mar 2017)	Early Transition Window (Oct 2014 – March 2017)	Narrow Transition Window (April 2015 - Dec 2016)
	Robust S.E.	**Robust S.E.**	**Robust S.E.**
	All	*All*	*All*
	Prop. (95% C.I.) p-value	**Prop. (95% C.I.) p-value**	**Prop. (95% C.I.) p-value**
Level			
HC II & III vs. HC IV & Hospital	**-0.128**** **(-0.205, -0.052)** **0.001**	**-0.125**** **(-0.201,-0.048)** **0.001**	**-0.126**** **(-0.204, -0.048)** **0.002**
Ownership			
PNFP vs. Government	-0.036 (-0.127, 0.055) 0.436	-0.051 (-0.156, 0.054) 0.339	-0.043 (-0.124, 0.038) 0.301
Post	**-0.143***** **(-0.202, -0.085)** **<0.001**	**-0.167***** **(-0.228, -0.107)** **<0.001**	**-0.119***** **(-0.169, -0.069)** **<0.001**
D-in-D			
PNFP x Post	0.036 (-0.082, 0.154) 0.553	0.052 (-0.087, 0.192) 0.463	0.037 (-0.076, 0.150) 0.523
Constant	**0.859***** **(0.819, 0.900)** **<0.001**	**0.882***** **(0.836, 0.928)** **<0.001**	**0.855***** **(0.819, 0.890)** **<0.001**
N obs.:	**465**	**392**	**628**
N facilities:	**117**	**114**	**123**
Public	97	96	102
PNFP	20	18	21

*Notes: *p<0.05, **p<0.01, ***p<0.001.*

Figure 35: Trends in Current on ART for Large Facilities (PNFP Facilities Disaggregated)



Chapter 7. References

1. Kates J, Wexler A, Lief E. Financing the Response to HIV in Low- and Middle-Income Countries in 2016. Kaiser Family Foundation, UNAIDS; 2017 July 21, 2017. Available from: https://www.kff.org/global-health-policy/report/donor-government-funding-for-hiv-in-low-and-middle-income-countries-in-2016/
2. Black R et al. Evaluation of PEPFAR. Washington, DC: Institute of Medicine; 2013 February 20, 2013.
3. PEPFAR. PEPFAR 3.0 Controlling the Epidemic: Delivering on the Promise of an AIDS-free Generation. 2014. Available from: http://www.pepfar.gov/documents/organization/234744.pdf
4. PEPFAR. Country/Regional Operational Plan (COP/ROP) 2015 Guidance. 2015 Fenruary 15, 2015. Available from: http://www.pepfar.gov/documents/organization/237669.pdf
5. UNAIDS. 90-90-90: An ambitious treatment target to help end the AIDS epidemic: UNAIDS; 2014. Available from: http://www.unaids.org/sites/default/files/media_asset/90-90-90_en.pdf.
6. PEPFAR. Country/Regional Operational Plan (COP/ROP) 2017 Guidance. 2016 December 30, 2016. Available from: https://www.pepfar.gov/documents/organization/266402.pdf
7. PEPFAR. Country/Regional Operational Plan (COP/ROP) 2016 Guidance. 2015 December 2015. Available from: http://www.pepfar.gov/documents/organization/250377.pdf
8. PEPFAR. Uganda Country Operational Plan 2017 Strategic Direction Summary. 2017 July 28, 2017. Available from: https://www.pepfar.gov/documents/organization/273638.pdf
9. Kiweewa J. Uganda's HIV/AIDS Success Story: Reviewing the Evidence. Journal of Development and Social Transformation. 2008;5(November):53-61, DOI:
10. Green EC, Halperin DT, Nantulya V, Hogle JA. Uganda's HIV prevention success: The role of sexual behavior change and the national response. Aids and Behavior. 2006;10(4):335-46, DOI: 10.1007/s10461-006-9073-y.
11. UNAIDS. Country factsheets: Uganda 2017 2018. Available from: http://www.unaids.org/en/regionscountries/countries/uganda.
12. Grebe E. The ambiguities of the 'partnership' between civil society and the state in Uganda's AIDS response during the 1990s and 2000s as demonstrated in the development of TASO. Glob Public Health. 2016;11(4):496-512, DOI: 10.1080/17441692.2015.1062121.
13. World Health Organization. Atlas of Health Statistics of the African Region 2014. Brazzaville, Republic of Congo: World Health Organization Regional Office for Africa; 2014. Available from: http://www.aho.afro.who.int/sites/default/files/publications/921/AFRO-Statistical_Factsheet.pdf
14. PEPFAR. Sustainability Planning Guidance Document – FY2014. 2013 October 2013. Available from: https://2009-2017.pepfar.gov/documents/organization/217767.pdf
15. PEPFAR. Uganda Country Operational Plan FY 2014. 2015 March 3, 2015. Available from: http://www.pepfar.gov/documents/organization/240270.pdf
16. Ministry of Health. National Health Expenditure Uganda 2017. Kampala, Uganda: Ministry of Health; 2018. Available from:

https://health.go.ug/sites/default/files/1.%20National%20Health%20Expenditure%20-%20Uganda%20Booklet.pdf
17. PEPFAR. Uganda Country Operational Plan (COP) 2015 Strategic Direction Summary. 2015 September 1, 2015. Available from: http://www.pepfar.gov/documents/organization/250305.pdf
18. Office of Management & Budget. America First: A Budget Blueprint to Make America Great Again. 2017 March 13, 2017. Available from: https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/2018_blueprint.pdf
19. Gramer R. Foreign Policy [Internet]2017 September 7, 2017. [September 12, 2018]. Available from: https://foreignpolicy.com/2017/09/07/congress-rejects-trump-plan-for-cutting-foreign-assistance-state-department-redesign-diplomacy-senate-appropriations/.
20. Ingram G. Up Front [Internet]: Brookings Institution. 2018. [cited 2018 September 11, 2018]. Available from: https://www.brookings.edu/blog/up-front/2018/06/04/erratic-budget-processes-threaten-us-foreign-aid/.
21. Stover J, Bollinger L, Izazola JA, Loures L, Delay P, Ghys PD, et al. What Is Required to End the AIDS Epidemic as a Public Health Threat by 2030? The Cost and Impact of the Fast-Track Approach (vol 11, e0154893, 2016). Plos One. 2016;11(6), DOI: 0.1371/journal.pone.0158253.
22. PEPFAR. Uganda Country Operational Plan FY 2016. 2017 Jan 18, 2017. Available from: https://www.pepfar.gov/documents/organization/250377.pdf
23. The Global Fund. Uganda Overview: The Global Fund; 2018; cited 2018. Available from: https://www.theglobalfund.org/en/portfolio/country/?k=9e8b8568-adaa-4b26-af09-da5b112c51e7&loc=UGA.
24. Oberth G, Whiteside A. What does sustainability mean in the HIV and AIDS response? Afr J AIDS Res. 2016;15(1):35-43, DOI: 10.2989/16085906.2016.1138976.
25. Bennett S, Singh S, Rodriguez D, Ozawa S, Singh K, Chhabra V, et al. Transitioning a Large Scale HIV/AIDS Prevention Program to Local Stakeholders: Findings from the Avahan Transition Evaluation. PLoS One. 2015;10(9):e0136177, DOI: 10.1371/journal.pone.0136177.
26. Kavanagh MM. The Politics and Epidemiology of Transition: PEPFAR and AIDS in South Africa. Jaids-J Acq Imm Def. 2014;65(3):247-50, DOI: 10.1097/Qai.0000000000000093.
27. Cloete C, Regan S, Giddy J, Govender T, Erlwanger A, Gaynes MR, et al. The Linkage Outcomes of a Large-scale, Rapid Transfer of HIV-infected Patients From Hospital-based to Community-based Clinics in South Africa. Open Forum Infect Di. 2014;1(2), DOI: 10.1093/ofid/ofu058.
28. Vogus A, Graff K. PEPFAR Transitions to Country Ownership: Review of Past Donor Transitions and Application of Lessons Learned to the Eastern Caribbean. Glob Health Sci Pract. 2015;3(2):274-86, DOI: 10.9745/GHSP-D-14-00227.
29. Cloete C, Regan S, Giddy J, Govender T, Erlwanger A, Gaynes MR, et al. The Linkage Outcomes of a Large-scale, Rapid Transfer of HIV-infected Patients From Hospital-based to Community-based Clinics in South Africa. Open Forum Infect Dis. 2014;1(2):ofu058, DOI: 10.1093/ofid/ofu058.
30. Katz IT, Bogart LM, Cloete C, Crankshaw TL, Giddy J, Govender T, et al. Understanding HIV-infected patients' experiences with PEPFAR-associated transitions at a Centre of Excellence

in KwaZulu Natal, South Africa: a qualitative study. AIDS Care. 2015;27(10):1298-303, DOI: 10.1080/09540121.2015.1051502.
31. Freeman A, Kiumbu M, Mwamba B, Atibu J, Mukumbi H, Mwila L, et al. Patient Outcomes in Lubumbashi, Democratic Republic of Congo After a Disruption in HIV Care Due to Decreased Global Fund Appropriations. Aids and Behavior. 2014;18(11):2135-43, DOI: 10.1007/s10461-014-0761-8.
32. Stash S CJ, Fisher M, Kramer A. Competing Pressures for U.S. PEPFAR in Botswana: Rising Ambitions, Declining Resources.: Center for Strategic & International Studies; 2012 November 2012. Available from: https://csis-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/publication/121128_Stash_PEPFARBotswana_Web.pdf
33. Sgaier SK, Ramakrishnan A, Dhingra N, Wadhwani A, Alexander A, Bennett S, et al. How the Avahan HIV prevention program transitioned from the Gates Foundation to the government of India. Health Aff (Millwood). 2013;32(7):1265-73, DOI: 10.1377/hlthaff.2012.0646.
34. Bennett S, Rodriguez D, Ozawa S, Singh K, Bohren M, Chhabra V, et al. Management practices to support donor transition: lessons from Avahan, the India AIDS Initiative. BMC Health Serv Res. 2015;15:232, DOI: 10.1186/s12913-015-0894-0.
35. Bennett S, Singh S, Ozawa S, Tran N, Kang JS. Sustainability of donor programs: evaluating and informing the transition of a large HIV prevention program in India to local ownership. Glob Health Action. 2011;4, DOI: 10.3402/gha.v4i0.7360.
36. MacKellar L. Priorities in global assistance for health, AIDS, and population. Popul Dev Rev. 2005;31(2):293-+, DOI: 10.1111/j.1728-4457.2005.00066.x.
37. Shiffman J. Donor funding priorities for communicable disease control in the developing world. Health Policy Plann. 2006;21(6):411-20, DOI: 10.1093/heapol/czl028.
38. Sridhar D, Batniji R. Misfinancing global health: a case for transparency in disbursements and decision making. Lancet. 2008;372(9644):1185-91, DOI: 10.1016/S0140-6736(08)61485-3.
39. England R, de Lay P, Greener R, Izazola JA. Are we spending too much on HIV? Brit Med J. 2007;334(7589):344-5, DOI: 10.1136/bmj.39113.402361.94.
40. Dieleman JL, Schneider MT, Haakenstad A, Singh L, Sadat NS, Birger M, et al. Development assistance for health: past trends, associations, and the future of international financial flows for health. Lancet. 2016;387(10037):2536-44, DOI: 10.1016/S0140-6736(16)30168-4.
41. Lordan G, Tang KK, Carmignani F. Has HIV/AIDS displaced other health funding priorities? Evidence from a new dataset of development aid for health. Social Science & Medicine. 2011;73(3):351-5, DOI: 10.1016/j.socscimed.2011.05.045.
42. Shiffman J, Berlan D, Hafner T. Has Aid for AIDS Raised All Health Funding Boats? Jaids-J Acq Imm Def. 2009;52:S45-S8, DOI: 10.1097/QAI.0b013e3181bbcb45.
43. Moucheraud C, Sparkes S, Nakamura Y, Gage A, Atun R, Bossert TJ. PEPFAR Investments In Governance And Health Systems Were One-Fifth Of Countries' Budgeted Funds, 2004-14. Health Aff (Millwood). 2016;35(5):847-55, DOI: 10.1377/hlthaff.2015.1445.
44. Dutta A, Wallace N, Savosnick P, Adungosi J, Kioko UM, Stewart S, et al. Investing in HIV services while building Kenya's health system: PEPFAR's support to prevent mother-to-child HIV transmission. Health Aff (Millwood). 2012;31(7):1498-507, DOI: 10.1377/hlthaff.2012.0227.

45. Lu C, Schneider MT, Gubbins P, Leach-Kemon K, Jamison D, Murray CJ. Public financing of health in developing countries: a cross-national systematic analysis. Lancet. 2010;375(9723):1375-87, DOI: 10.1016/S0140-6736(10)60233-4.
46. Van de Sijpe N. The Fungibility of Health Aid Reconsidered. J Dev Stud. 2013;49(12):1746-54, DOI: 10.1080/00220388.2013.819424.
47. Dieleman JL, Graves CM, Hanlon M. The Fungibility of Health Aid: Reconsidering the Reconsidered. J Dev Stud. 2013;49(12):1755-62, DOI: 10.1080/00220388.2013.844921.
48. Stierman E, Ssengooba F, Bennett S. Aid alignment: a longer term lens on trends in development assistance for health in Uganda. Globalization Health. 2013;9, DOI: 10.1186/1744-8603-9-7.
49. Ministry of Health. NATIONAL HEALTH EXPENDITURE Financial Year 2010/11 and 2011/12. 2013 2013. Available from: http://health.go.ug/docs/NHA_REPORT_FINAL_13.pdf
50. World Health Organization. Global Health Expenditure Database. 2014. Available from: http://apps.who.int/nha/database/ViewData/Indicators/en
51. Bajunirwe F, Twesigye L, Zhang M, Kerry VB, Bangsberg DR. Influence of the US President's Emergency Plan for AIDS Relief (PEPfAR) on career choices and emigration of health-profession graduates from a Ugandan medical school: a cross-sectional study. BMJ Open. 2013;3(5), DOI: 10.1136/bmjopen-2013-002875.
52. Biesma RG, Brugha R, Harmer A, Walsh A, Spicer N, Walt G. The effects of global health initiatives on country health systems: a review of the evidence from HIV/AIDS control. Health Policy Plann. 2009;24(4):239-52, DOI: 10.1093/heapol/czp025.
53. Brugha R, Kadzandira J, Simbaya J, Dicker P, Mwapasa V, Walsh A. Health workforce responses to global health initiatives funding: a comparison of Malawi and Zambia. Hum Resour Health. 2010;8:19, DOI: 10.1186/1478-4491-8-19.
54. Manzi F, Schellenberg JA, Hutton G, Wyss K, Mbuya C, Shirima K, et al. Human resources for health care delivery in Tanzania: a multifaceted problem. Human Resources for Health. 2012;10, DOI: 10.1186/1478-4491-10-3.
55. Chen L, Evans T, Anand S, Boufford JI, Brown H, Chowdhury M, et al. Human resources for health: overcoming the crisis. Lancet. 2004;364(9449):1984-90, DOI: 10.1016/S0140-6736(04)17482-5.
56. Lohman N, Hagopian A, Luboga SA, Stover B, Lim T, Makumbi F, et al. District Health Officer Perceptions of PEPFAR's Influence on the Health System in Uganda, 2005-2011. Int J Health Policy Manag. 2016;6(2):83-95, DOI: 10.15171/ijhpm.2016.98.
57. Grepin KA. HIV donor funding has both boosted and curbed the delivery of different non-HIV health services in sub-Saharan Africa. Health Aff (Millwood). 2012;31(7):1406-14, DOI: 10.1377/hlthaff.2012.0279.
58. Chima CC, Franzini L. Spillover effect of HIV-specific foreign aid on immunization services in Nigeria. Int Health. 2016;8(2):108-15, DOI: 10.1093/inthealth/ihv036.
59. Rasschaert F, Pirard M, Philips MP, Atun R, Wouters E, Assefa Y, et al. Positive spill-over effects of ART scale up on wider health systems development: evidence from Ethiopia and Malawi. J Int AIDS Soc. 2011;14 Suppl 1:S3, DOI: 10.1186/1758-2652-14-S1-S3.
60. Hontelez JA, Tanser FC, Naidu KK, Pillay D, Barnighausen T. The Effect of Antiretroviral Treatment on Health Care Utilization in Rural South Africa: A Population-Based Cohort Study. PLoS One. 2016;11(7):e0158015, DOI: 10.1371/journal.pone.0158015.

61. Kruk ME, Jakubowski A, Rabkin M, Kimanga DO, Kundu F, Lim T, et al. Association between HIV programs and quality of maternal health inputs and processes in Kenya. Am J Public Health. 2015;105 Suppl 2:S207-10, DOI: 10.2105/AJPH.2014.302511.
62. Kruk ME, Jakubowski A, Rabkin M, Elul B, Friedman M, El-Sadr W. PEPFAR programs linked to more deliveries in health facilities by African women who are not infected with HIV. Health Aff (Millwood). 2012;31(7):1478-88, DOI: 10.1377/hlthaff.2012.0197.
63. Brugha R, Simbaya J, Walsh A, Dicker P, Ndubani P. How HIV/AIDS scale-up has impacted on non- HIV priority services in Zambia. BMC Public Health. 2010;10:540, DOI: 10.1186/1471-2458-10-540.
64. Potter D, Goldenberg RL, Chao A, Sinkala M, Degroot A, Stringer JS, et al. Do targeted HIV programs improve overall care for pregnant women?: Antenatal syphilis management in Zambia before and after implementation of prevention of mother-to-child HIV transmission programs. J Acquir Immune Defic Syndr. 2008;47(1):79-85, DOI: 10.1097/QAI.0b013e31815d2f71.
65. Mutabazi JC, Zarowsky C, Trottier H. The impact of programs for prevention of mother-to-child transmission of HIV on health care services and systems in sub-Saharan Africa - A review. Public Health Rev. 2017;38:28, DOI: 10.1186/s40985-017-0072-5.
66. Matsubayashi T, Manabe YC, Etonu A, Kyegombe N, Muganzi A, Coutinho A, et al. The effects of an HIV project on HIV and non-HIV services at local government clinics in urban Kampala. BMC Int Health Hum Rights. 2011;11 Suppl 1:S9, DOI: 10.1186/1472-698X-11-S1-S9.
67. Luboga SA, Stover B, Lim TW, Makumbi F, Kiwanuka N, Lubega F, et al. Did PEPFAR investments result in health system strengthening? A retrospective longitudinal study measuring non-HIV health service utilization at the district level. Health Policy Plan. 2016;31(7):897-909, DOI: 10.1093/heapol/czw009.
68. Wollum A, Dansereau E, Fullman N, Achan J, Bannon KA, Burstein R, et al. The effect of facility-based antiretroviral therapy programs on outpatient services in Kenya and Uganda. BMC Health Serv Res. 2017;17(1):564, DOI: 10.1186/s12913-017-2512-9.
69. Bennett S, Ozawa S, Rodriguez D, Paul A, Singh K, Singh S. Monitoring and evaluating transition and sustainability of donor-funded programs: Reflections on the Avahan experience. Eval Program Plann. 2015;52:148-58, DOI: 10.1016/j.evalprogplan.2015.05.003.
70. Binagwaho A, Kankindi I, Kayirangwa E, Nyemazi JP, Nsanzimana S, Morales F, et al. Transitioning to Country Ownership of HIV Programs in Rwanda. PLoS Med. 2016;13(8):e1002075, DOI: 10.1371/journal.pmed.1002075.
71. Dave Burrows GO, Danielle Parsons, and Lou McCallum. Transitions from donor funding to domestic reliance for HIV responses: Recommendations for transitioning countries APMGlobal Health; Aidspan; 2016. Available from: http://apmglobalhealth.com/sites/apmglobalhealth.com/files/documents/transition_from_donor_funding_apmg_aidspanfinal.pdf
72. Farmer PE, Nutt CT, Wagner CM, Sekabaraga C, Nuthulaganti T, Weigel JL, et al. Reduced premature mortality in Rwanda: lessons from success. BMJ. 2013;346:f65, DOI: 10.1136/bmj.f65.
73. Freeman A, Kiumbu M, Mwamba B, Atibu J, Mukumbi H, Mwila L, et al. Patient outcomes in Lubumbashi, Democratic Republic of Congo after a disruption in HIV care due to

decreased global fund appropriations. AIDS Behav. 2014;18(11):2135-43, DOI: 10.1007/s10461-014-0761-8.
74. Patcharanarumol W, Thammatacharee N, Kittidilokkul S, Topothai T, Thaichinda C, Suphanchaimat R, et al. Thailand's HIV/AIDS program after weaning-off the global fund's support. BMC Public Health. 2013;13:1008, DOI: 10.1186/1471-2458-13-1008.
75. Rodriguez DC, Whiteside A, Bennett S. Political commitment for vulnerable populations during donor transition. Bull World Health Organ. 2017;95(2):121-7, DOI: 10.2471/BLT.16.179861.
76. Bennett S, Fairbank A. A Conceptual Framework for Analyzing the System-wide Effects of the Global Funds: A Conceptual Framework. Partners for Health Reform plus Project; 2003 October 2003. Available from: http://www.phrplus.org/Pubs/Tech031_fin.pdf
77. Stillman K, Bennett S. Systemwide Effects of the Global Fund: Interim Findings from Three Country Studies. Bethesda, MD: The Partners for Health Reformplus Project; 2005 September 2005. Available from: https://www.theglobalfund.org/media/1523/library_iepnadf196_report_en.pdf?u=636675998770000000
78. Warren AE, Wyss K, Shakarishvili G, Atun R, de Savigny D. Global health initiative investments and health systems strengthening: a content analysis of global fund investments. Globalization Health. 2013;9, DOI: 10.1186/1744-8603-9-30.
79. Kapilashrami A, Hanefeld J. Meaningful change or more of the same? The Global Fund's new funding model and the politics of HIV scale-up. Glob Public Health. 2014;9(1-2):160-75, DOI: 10.1080/17441692.2014.881524.
80. Yu DB, Souteyrand Y, Banda MA, Kaufman J, Perriens JH. Investment in HIV/AIDS programs: Does it help strengthen health systems in developing countries? Globalization Health. 2008;4, DOI: 10.1186/1744-8603-4-8.
81. Oliveira Cruz V, McPake B. Global Health Initiatives and aid effectiveness: insights from a Ugandan case study. Global Health. 2011;7:20, DOI: 10.1186/1744-8603-7-20.
82. Brugha R. Global health initiatives and public health policy. In: Heggenhougen K QS, editor. International Encyclopedia of Public Health. San Diego, CA: Academic Press; 2008. p. 72-81.
83. World Health Organization. The WHO Health Systems Framework 2018. Available from: http://www.wpro.who.int/health_services/health_systems_framework/en/.
84. Ministry of Health. Uganda's Electronic Health Information System 2018. Available from: https://hmis1.health.go.ug/hmis2/dhis-web-commons/security/login.action.
85. Ministry of Health. Audit Summary District 2017. Available from: http://hris.health.go.ug/districts_manage/index.php/audit_summary_districts.
86. Car J, Paljarvi T, Car M, Kazeem A, Majeed A, Atun R. Negative health system effects of Global Fund's investments in AIDS, tuberculosis and malaria from 2002 to 2009: systematic review. JRSM Short Rep. 2012;3(10):70, DOI: 10.1258/shorts.2012.012062.
87. Palen J, El-Sadr W, Phoya A, Imtiaz R, Einterz R, Quain E, et al. PEPFAR, health system strengthening, and promoting sustainability and country ownership. J Acquir Immune Defic Syndr. 2012;60 Suppl 3:S113-9, DOI: 10.1097/QAI.0b013e31825d28d7.
88. Cailhol J, Craveiro I, Madede T, Makoa E, Mathole T, Parsons AN, et al. Analysis of human resources for health strategies and policies in 5 countries in Sub-Saharan Africa, in

response to GFATM and PEPFAR-funded HIV-activities. Global Health. 2013;9:52, DOI: 10.1186/1744-8603-9-52.
89. Vujicic M, Weber SE, Nikolic IA, Atun R, Kumar R. An analysis of GAVI, the Global Fund and World Bank support for human resources for health in developing countries. Health Policy Plan. 2012;27(8):649-57, DOI: 10.1093/heapol/czs012.
90. Mussa AH, Pfeiffer J, Gloyd SS, Sherr K. Vertical funding, non-governmental organizations, and health system strengthening: perspectives of public sector health workers in Mozambique. Hum Resour Health. 2013;11:26, DOI: 10.1186/1478-4491-11-26.
91. Global Burden of Disease Compare: University of Washington, Institute of Health Metrics and Evaluation; 2018. Available from: https://vizhub.healthdata.org/gbd-compare/.
92. Topp SM, Chipukuma JM. How did rapid scale-up of HIV services impact on workplace and interpersonal trust in Zambian primary health centres: a case-based health systems analysis. BMJ Glob Health. 2016;1(4):e000179, DOI: 10.1136/bmjgh-2016-000179.
93. Fan VY, Tsai FJ, Shroff ZC, Nakahara B, Vargha N, Weathers S. Dedicated health systems strengthening of the Global Fund to Fight AIDS, Tuberculosis, and Malaria: an analysis of grants. Int Health. 2017;9(1):50-7, DOI: 10.1093/inthealth/ihw055.
94. Tsai FJ, Lee H, Fan VY. Perspective and investments in health system strengthening of Gavi, the Vaccine Alliance: a content analysis of health system strengthening-specific funding. Int Health. 2016;8(4):246-52, DOI: 10.1093/inthealth/ihv063.
95. Zakumumpa H, Taiwo MO, Muganzi A, Ssengooba F. Human resources for health strategies adopted by providers in resource-limited settings to sustain long-term delivery of ART: a mixed-methods study from Uganda. Hum Resour Health. 2016;14(1):63, DOI: 10.1186/s12960-016-0160-5.
96. De Neve JW, Garrison-Desany H, Andrews KG, Sharara N, Boudreaux C, Gill R, et al. Harmonization of community health worker programs for HIV: A four-country qualitative study in Southern Africa. PLoS Med. 2017;14(8):e1002374, DOI: 10.1371/journal.pmed.1002374.
97. Cairney LI, Kapilashrami A. Confronting 'scale-down': assessing Namibia's human resource strategies in the context of decreased HIV/AIDS funding. Glob Public Health. 2014;9(1-2):198-209, DOI: 10.1080/17441692.2014.881525.
98. Uganda USM. U.S. Government Launches Project to Improve Health Services in Acholi Region Kampala, Uganda: U.S Embassy in Uganda; 2017. Available from: https://ug.usembassy.gov/u-s-government-launches-project-improve-health-services-acholi-region/.
99. StataCorp. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC; 2017.
100. Mbindyo PM, Blaauw D, Gilson L, English M. Developing a tool to measure health worker motivation in district hospitals in Kenya. Hum Resour Health. 2009;7:40, DOI: 10.1186/1478-4491-7-40.
101. Ministry of Health. Human Resources for Health Information System: Uganda Ministry of Health; 2017. Available from: http://hris.health.go.ug/.
102. Ministry of Health. Approved staffing Norms at Various Levels. Kampala, Uganda: Ministry of Health; 2014. Available from: http://library.health.go.ug/publications/health-workforce/human-resource-management/approved-staffing-norms-various-levels

103. Human Resources for Health Audit Report, 2015. Ugandan Ministry of Health; 2015. Available from: http://library.health.go.ug/publications/health-workforce/human-resource-management/human-resources-health-audit-report-2015
104. Corbett MC, Mathenge W, Zondervan M, Astbury N. Cascading training the trainers in ophthalmology across Eastern, Central and Southern Africa. Global Health. 2017;13(1):46, DOI: 10.1186/s12992-017-0269-x.
105. Mays DC, O'Neil EJ, Jr., Mworozi EA, Lough BJ, Tabb ZJ, Whitlock AE, et al. Supporting and retaining Village Health Teams: an assessment of a community health worker program in two Ugandan districts. Int J Equity Health. 2017;16(1):129, DOI: 10.1186/s12939-017-0619-6.
106. Lubogo M, Anguzu R, Wanzira H, Namugwanya I, Namuddu O, Ssali D, et al. Willingness by people living with HIV/AIDS to utilize HIV services provided by Village Health team workers in Kalungu district, central Uganda. Afr Health Sci. 2017;17(1):216-24, DOI: 10.4314/ahs.v17i1.27.
107. Ruzagira E, Grosskurth H, Kamali A, Baisley K. Brief counselling after home-based HIV counselling and testing strongly increases linkage to care: a cluster-randomized trial in Uganda. J Int AIDS Soc. 2017;20(2), DOI: 10.1002/jia2.25014.
108. Bemelmans M, Baert S, Negussie E, Bygrave H, Biot M, Jamet C, et al. Sustaining the future of HIV counselling to reach 90-90-90: a regional country analysis. J Int AIDS Soc. 2016;19(1):20751, DOI: 10.7448/IAS.19.1.20751.
109. Okoboi S, Ding E, Persuad S, Wangisi J, Birungi J, Shurgold S, et al. Community-based ART distribution system can effectively facilitate long-term program retention and low-rates of death and virologic failure in rural Uganda. AIDS Res Ther. 2015;12:37, DOI: 10.1186/s12981-015-0077-4.
110. Freeman PA, Schleiff M, Sacks E, Rassekh BM, Gupta S, Perry HB. Comprehensive review of the evidence regarding the effectiveness of community-based primary health care in improving maternal, neonatal and child health: 4. child health findings. J Glob Health. 2017;7(1):010904, DOI: 10.7189/jogh.07.010904.
111. Wouters E, Van Damme W, Van Loon F, van Rensburg D, Meulemans H. Public-sector ART in the Free State Province, South Africa: community support as an important determinant of outcome. Soc Sci Med. 2009;69(8):1177-85, DOI: 10.1016/j.socscimed.2009.07.034.
112. Vaughan K, Kok MC, Witter S, Dieleman M. Costs and cost-effectiveness of community health workers: evidence from a literature review. Hum Resour Health. 2015;13:71, DOI: 10.1186/s12960-015-0070-y.
113. Angrist J. PJS. Mostly Harmless Econometrics: Chapter 5.2. Mostly Harmless Econometrics. Princeton, NJ: Princeton University Press; 2008.
114. Bertrand M, Duflo E, Mullainathan S. How much should we trust differences-in-differences estimates? Q J Econ. 2004;119(1):249-75, DOI: 10.1162/003355304772839588.
115. AidsInfo Estimates: UNAIDS; 2018. Available from: http://aidsinfo.unaids.org/.
116. ICF, Uganda Bureau of Statistics. Uganda Demographic and Health Survey 2016. Kampala, Uganda and Rockville, Maryland, USA: UBOS and ICF; 2018.
117. Rao P, Gabre-Kidan T, Mubangizi DB, Sulzbach S. Leveraging the private health sector to enhance HIV service delivery in lower-income countries. J Acquir Immune Defic Syndr. 2011;57 Suppl 2:S116-9, DOI: 10.1097/QAI.0b013e31821ed719.
118. Brugha R. Antiretroviral treatment in developing countries: the peril of neglecting private providers. BMJ. 2003;326(7403):1382-4, DOI: 10.1136/bmj.326.7403.1382.

119. Kakaire T, Schlech W, Coutinho A, Brough R, Parkes-Ratanshi R. The future of financing for HIV services in Uganda and the wider sub-Saharan Africa region: should we ask patients to contribute to the cost of their care? BMC Public Health. 2016;16:896, DOI: 10.1186/s12889-016-3573-0.
120. O'Hanlon B, Nakyanzi A, Musembi V, Busulwa I, Husband R, Okumu R, Zikusooka F, Batusa J, Kiragga D, Byakika S, Musila T, Kyambadde A. Exploring partnership opportunities to achieve universal health access: 2016 Uganda private sector assessment in health. 2017 February 2017. Available from: Cardno Emerging Markets USA, Ltd.
121. Paina L. Dual practice in Kampala, Uganda: a mixed methods study of management and policy. Baltimore, MD: Johns Hopkins University; 2014.
122. Coutinho A, Roxo U, Epino H, Muganzi A, Dorward E, Pick B. The expanding role of civil society in the global HIV/AIDS response: what has the President's Emergency Program For AIDS Relief's role been? J Acquir Immune Defic Syndr. 2012;60 Suppl 3:S152-7, DOI: 10.1097/QAI.0b013e31825d0383.
123. Mildmay: Who We Are 2018. Available from: https://mildmay.or.ug/who-we-are.
124. Ssennyonjo A, Namakula J, Kasyaba R, Orach S, Bennett S, Ssengooba F. Government resource contributions to the private-not-for-profit sector in Uganda: evolution, adaptations and implications for universal health coverage. Int J Equity Health. 2018;17(1):130, DOI: 10.1186/s12939-018-0843-8.
125. Mandelli A KL, Scribner S. Survey of Private Health Facilities in Uganda. Bethesda, MD: Abt Associates Inc.; 2005 September 2005. Available from: www.phtplus.org/Pubs/Tech073_fin.pdf
126. Asiimwe D. Identification of priority research questions within the areas of: health financing; human resources for health and the role of non-state sector. Kampala, Uganda: Makerere Institute of Social Research; 2008 Aug 6, 2008. Available from: http://www.who.int/alliance-hpsr/researchsynthesis/Alliance%20HPSR%20IPRQ_Makere_Report.pdf
127. Grepin KA. Private Sector An Important But Not Dominant Provider Of Key Health Services In Low- And Middle-Income Countries. Health Aff (Millwood). 2016;35(7):1214-21, DOI: 10.1377/hlthaff.2015.0862.
128. Johnson D, Cheng X. The role of private health providers in HIV testing: analysis of data from 18 countries. Int J Equity Health. 2014;13:36, DOI: 10.1186/1475-9276-13-36.
129. Wang W, Sulzbach S, De S. Utilization of HIV-related services from the private health sector: A multi-country analysis. Soc Sci Med. 2011;72(2):216-23, DOI: 10.1016/j.socscimed.2010.11.011.
130. Uganda AIDS Commission. National AIDS Spending Assessment - Uganda 2008/9 – 2009/10. Kampala, Uganda: Ugandan AIDS Commission; 2012 June 2012. Available from: http://files.unaids.org/en/media/unaids/contentassets/documents/data-and-analysis/tools/nasa/20140707/uganda_2008-2010_en.pdf
131. Twimukye A, King R, Schlech W, Zawedde FM, Kakaire T, Parkes-Ratanshi R. Exploring attitudes and perceptions of patients and staff towards an after-hours co-pay clinic supplementing free HIV services in Kampala, Uganda. BMC Health Serv Res. 2017;17(1):580, DOI: 10.1186/s12913-017-2524-5.

132. Konde-Lule J, Gitta SN, Lindfors A, Okuonzi S, Onama VO, Forsberg BC. Private and public health care in rural areas of Uganda. BMC Int Health Hum Rights. 2010;10:29, DOI: 10.1186/1472-698X-10-29.
133. Sulzbach S, De S, Wang W. The private sector role in HIV/AIDS in the context of an expanded global response: expenditure trends in five sub-Saharan African countries. Health Policy Plan. 2011;26 Suppl 1:i72-84, DOI: 10.1093/heapol/czr031.
134. Igumbor J, Pascoe S, Rajap S, Townsend W, Sargent J, Darkoh E. A South African public-private partnership HIV treatment model: viability and success factors. PLoS One. 2014;9(10):e110635, DOI: 10.1371/journal.pone.0110635.
135. FY2017 U.S. Global AIDS Budget: The Human Impact: The Foundation for AIDS Research (amfAR); 2016. Available from: https://www.amfar.org/Global-AIDS-Budget-Impact/.
136. Govt's new Test & Treat' policy blamed for ARVs stockouts. The Observer. 2017 November 30, 2017. Available from: https://observer.ug/news/headlines/56239-govt-s-new-test-treat-policy-blamed-for-arvs-stockouts.html
137. UNAIDS. Country Factsheet - Rwanda 2018 updated September 6, 2018. Available from: http://www.unaids.org/en/regionscountries/countries/rwanda.
138. The Global Fund Sustainability, Transition and Co-financing Policy. 2016 26-27 April 2016,. Available from: https://www.theglobalfund.org/media/4221/bm35_04-sustainabilitytransitionandcofinancing_policy_en.pdf
139. McCarthy J, Mahajan S. Foreing Aid Was a Big Winner in the Budget Trump Signed Last Week. Global Citizen. 2018. [cited 2018]. Available from: https://www.globalcitizen.org/en/content/foreign-aid-victories-in-trumps-2018-budget/.
140. National Malaria Control Program: Ministry of Health, Republic of Uganda. Available from: http://health.go.ug/programs/national-malaria-control-program.
141. Millennium Development Goal 5: World Health Organization; 2000. Available from: http://www.who.int/reproductivehealth/topics/mdgs/target_5a/en/.
142. Lewis RF, Kisakye A, Gessner BD, Duku C, Odipio JB, Iriso R, et al. Action for child survival: elimination of Haemophilus influenzae type b meningitis in Uganda. Bull World Health Organ. 2008;86(4):292-301, DOI:

Curriculum Vitae

Jess Wilhelm received his PhD in International Health, Health Systems, and a master's of health science (MHS) degree in Biostatistics from Johns Hopkins University in 2018. He also holds a master's degree in International Development from the University of Pittsburgh and a Bachelor's of Science from Ohio University in Astrophysics. Jess has worked as a Doctoral Research Assistant for Johns Hopkins University from 2015–2018. He was a Research Associate for the Health Policy and Data Analysis division of Social & Scientific Systems, Inc. in 2014–2015 and served as a Peace Corps volunteer in Lesotho in 2011–2013. He speaks French, Sesotho, and Mandarin Chinese.